THE PRODUCTION AND UTILIZATION OF SILAGE

A Review of World Literature in Abstracts

Bulletin No. 40 of the Commonwealth Bureau of Pastures and Field Crops

Commonwealth Agricultural Bureaux

COMMONWEALTH AGRICULTURAL BUREAUX

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Ensilage as a farming practice is now well established, yet it is remarkable what difference of opinion exists on fundamental aspects. The Scandinavian workers practically all use the AIV method, the British emphasis is on pit silage without preservative, the American work on grass silage is primarily interested in wilting, the New Zealanders claim very high losses of nutritive value in the ensilage process. It has unfortunately not been possible to produce a balanced review of the whole problem, but instead abstracts of all papers and other publications which have appeared over a period of some 15 to 20 years have been brought together under one cover, in order that this may serve as a reference book to the very extensive literature.

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OF THE

COMMONWEALTH BUREAU OF PASTURES AND FIELD CROPS

PENGLAIS, ABERYSTWYTH

GREAT BRITAIN

First published 1949

MADE AND PRINTED IN GREAT BRITAIN BY
THE CAMBRIAN NEWS (ABERYSTWYTH) LTD.,
ABERYSTWYTH

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A. INTRODUCTION

It is regretted that it has not been possible to produce a properly balanced review of the production and utilization of silage in all its aspects, as is being done in our partner Bulletin to this on the production and utilization of artificially dried fodders. The great majority of the abstracts published in this Bulletin have already appeared in *Herbage Abstracts* ; for some we have been obliged to turn to *Nutrition Abstracts and Reviews* and *Dairy Science Abstracts* and we take this opportunity of expressing our indebtedness to the Editors concerned ; for others we have considered it advisable to quote the authors' summaries.

An attempt has been made to include all papers dealing with scientific research on silage, but only a few of the great many papers on the practical aspects, particularly those giving advice and instructions to farmers. The abstracts in Section C are in the geographical order of the Decimal Classification, all other chapters are in alphabetical order. The classification into main sections is only a rough one, as many papers deal with more than one aspect.

The abstracts are those which were published shortly after the paper itself appeared ; some may therefore be primarily of historical value, and may contain references to facts, results or impressions which are obviously no longer applicable. The addresses of authors given at the end of the titles are again the addresses at the time of publication, and many have since changed. Abstracts taken from the other two C.A.B. abstracting journals referred to above are acknowledged by the initials N.A. and R. and D.S.A. respectively. Because of the different sources used, there may be a certain lack of uniformity in editorial practice, such as for example in the transliteration of Russian names and words, or in the quoting of American spelling.

To those who would prefer an authoritative review on these questions, reference should, of course, be made to Professor Stephen Watson's " The Science and Practice of Conservation : Grass and Forage Crops " published in two volumes in 1939 by " *The Fertilizer and Feeding Stuffs Journal* " London, and to his recent review in *Nutrition Abstracts and Reviews*, Vol. 18, No. 1, 1948.

There are a number of general points which a proper review of the subject might have brought out: for example, the apparent and enthusiastic single-mindedness as regards the AIV method of making silage in the Scandinavian countries and Finland, the confusion which seems to exist in informed quarters in Great Britain as to the best methods to adopt (witnessed by discussions at meetings of the British Grassland Society, and by the special visit made in June 1948 by a small party of British agriculturists to Scandinavia and Finland on behalf of a weekly farming paper), and the general trend in the Eastern United States away from the use of molasses as a preservative to no preservative and partial wilting of grass silage in the field prior to transporting to the silo. There are also indications that silage can be made successfully under tropical conditions, and that this method might well be preferable to the artificial drying of grass under these conditions; the low protein content of the flushes of tropical growth which it is desired to conserve for periods of drought would appear to make the more expensive artificial method uneconomic.

Most of the publications referred to in this Bulletin are available for purposes of further study in the Library of the publishing Bureau, or can be sent on loan to reputable persons within the United Kingdom.

The omission of any works should not be taken as discrimination against a particular author or published article, but merely as an indication that no bibliography on such a subject can ever be complete. The Bureau would like to have news of any important recent works which may have been omitted.—R. O. Whyte.

B. GENERAL

GENERAL

AGRICULTURAL RESEARCH COUNCIL. Rep. Series No. 1. **A report of a Committee on the Preservation of Grass and Other Fodder Crops.** 1935. pp. 35. **1**

ALVES, L., and SILVA, M. T. da. Conservação da forragem. Silo, silagem e ensilagem. [**The conservation of forage. Silos, silage and ensilage.**] 2nd edn. 23 × 16. pp. 231. Charts. Rio de Janeiro: [For the] Ministerio da Agricultura; Directoria de Estatistica da Producção. 1936. **2**

A complete consideration of the practice of ensilage is arranged as follows. General considerations and a review of ensilage in the United States and in various South American countries (pp. 3-73). A description of the different types of silo, with special reference to their construction (pp. 75-129), costs and the question of upkeep also being considered. The technique of cutting, carrying, loading, and stamping down; the addition of water; the costs involved (pp. 131-51). The chemical principles underlying the process (pp. 153-61). Crops suitable for ensilage and the technique advisable in each case; maize (considered the best crop), sorghum, sugar cane, *Hyparrhenia rufa*, *Brachiaria plantaginea* and other grasses, pasture herbage, lucerne, clover, *Arachis hypogaea* (the leaves), *Vigna sinensis*, *Stizolobium aterrimum*, *Phaseolus panduratus*, grass-legume mixtures, sweet potatoes, sunflowers (pp. 163-201). Nutritional aspect of the subject (pp. 203-23). Four essentials of success (pp. 225-8). The book is copiously illustrated by photographs and diagrams.

Of the silos described, the authors consider the hillside silo to present the ideal type. This, of cylindrical form and constructed in the side of a hill or embankment, does away with the necessity of using cement in building and of employing an elevator for filling it. Filling is done from the top of the hill or embankment, the silage being removed on the lower side. Its one disadvantage is that it is not always possible to locate it close to the feeding place. (Illustrations on pp. 51, 53, 117, 119, 123.) Essentials of success are (1) that the silo be airtight; (2) that, on account of the abnormal fermentation produced by the admission of air to a silo, emptying should be carried out at the rate of one layer of silage per day, the minimum thickness of which should be 5 cm. in cold weather, and 7.5 cm. in summer; (3) that the diameter of a silo should be determined in relation to the minimum number of animals to be fed; and (4) a silo should always be emptied in horizontal layers, from the top downwards.

AXELSSON, J., and ANDERSSON, Y. Foderkonservering. [**Fodder conservation.**] Nordisk Rotogravyr, Stockholm, 1935. pp. 200. **3**

Utilizing the literature available, the authors have sought in this work to give a summary of what is of interest in the execution of fodder conservation and the evaluation and employment of the fodders obtained thereby. The book contains four chapters, of which chapter I deals with ensiling, chapter II with hay curing, chapter III with artificial drying, and chapter IV with the practical carrying out of fodder conservation. A comprehensive bibliography is appended for the use of those who wish to study certain problems more profoundly than can be done in the book under review.—[From review by J. Axelsson in *Nord. JordbrForskn.* 17. 160. 1935.]

BENDER, C. B., and BOSSHARDT, D. K. **Grass silage: a critical review of the literature.** *J. Dairy Sci.* 22. 637-51. 1939. **4**

The review presents a general picture of the factors involved in the ensiling of crops and the operation of these factors under the various methods (e.g. the use of acid or molasses) which have been used for silage making. The value of silage for milk production and the influence of silage, with its accompanying break-down products, on milk and milk products are examined. [D.S.A.]

BRIDGES, A. **Some economic aspects of grass conservation.** *Pap. 3rd Oxford Fmg Conf.* 1938. pp. 116-25. [Discussion, 125-32] **5**

CRASEMANN, E. Der derzeitige Stand der Grunfutterkonservierung. [**The present state of our knowledge of the preservation of green fodder.**] *Schweiz. landw. Mh.* 1937. No. 2. 33-58. **6**

ENGLAND AND WALES, Ministry of Agriculture and Fisheries. Bull. No. 37. **Ensilage.** 6th edn. By *H. E. Woodman* and *A. Amos.* 1944. pp. 64. **7**

An account of knowledge of ensilage and of methods practised in this country. Due to war conditions, greater use has to be made of home-grown food for livestock, and the making of silage has consequently become extremely important. Young, leafy grass in particular gives rise to silage capable of contributing both to the maintenance and production requirements of dairy cows.

The main items dealt with are—types of silage, suitable crops for ensiling, the making of silage in tower, clamp, stock and pit silos, the chemistry and the feeding of silage. Finally, it is stated that recent advances in the knowledge of the practice of ensilage indicate the possibility of making silage of high quality and feeding value, both from forage and from young grass, without having to erect expensive tower silos.

GIULIANI, R. Il problema foraggero e la moderna tecnica dell' insilamento. [**The forage problem and modern ensiling technique.**] *Riv. Zootec.* 14. 89-92, 94-6, 99-100, 105, 133-6, 139-40, 143-4, and 149-56. 1937. **8**

HEATH, W. E. **Economics of hay, dried grass and grass silage.** *Scot. J. Agric.* 27. 149-52. 1948. **9**

The principles which should govern a decision concerning the place of the three commodities, hay, dried grass and grass silage in the farm economy are outlined.

LING, A. W., and PEEL, W. R. **Grass silage and silos.** *J. Soc. chem. Ind.* 55. 45-52. 1936. **10**

The history, theory and technique of grass silage manufacture are reviewed mostly in the light of recent experience by the authors and their colleagues. A selected bibliography on the subject is added. [N. A. and R.]

MORRISON, F. B. **Feeds and feeding.** 20th Edn. Morrison Publishing Co., Ithaca, N.Y. 1936. pp. 1050. **11**

RUSCHMANN, G. Die wissenschaftlichen Grundlagen der Gärfutterbereitung. [**The scientific basis of silage production.**] *Landw. Jb.* 88. 135-295. 1939. **12**

STAPLEDON, Sir R. G. **The importance of grass conservation.** *J. Minist. Agric.* 54. 433-7. 1948. **13**

Certain aspects of fodder conservation are considered rather than the technicalities of making hay or silage, or those connected with drying grass. The importance of periodic resort to the mowing machine to get the best out of permanent grass and leys is stressed. When abundant conservation cuts alternate with grazing as part of the ley management, the gross amount of grazing eatables per unit of area per year is vastly increased, apart from the grass conserved. A reduction in the size of paddocks and the installation of additional water points is suggested as a means by which management of the grassland and the leys in particular might be improved. This should ensure a minimum of waste and a maximum of conservation.

It is felt that the whole technique of growing and curing hay calls for a vast amount of fundamental and practical research and that the " laborious " method of tripoding should be more generally explored. Silage should be of high quality and made on a contract or co-operative basis for the smaller farmers. Peripatetic gangs with appropriate implements, each in the charge of a well-trained (and expert silage-maker) foreman are suggested for all the higher rainfall

and grassy districts. The complementary nature of silage and dried grass is stated, together with certain merits of the latter—e.g. ease of handling and transport. The lessons of the Milk Marketing Board's grass-drying experiments at Thornbury are noted and it is concluded that to get the best out of our grassland there should be a move in the direction of contractual operations for silage making, grass drying and the cultivations demanded for reseeding, whether it be direct or after a run of crops.

WATSON, S. J. **The nutritive value of grass and some of its by-products.** *Agric. Progr.* 9. 62-4. 1932. **14**

A brief review of work at Jealott's Hill on silage, artificial drying, etc.

WATSON, S. J. **Silage and crop preservation.** 23 × 15. pp. x + 192. pls. London: Macmillan and Co., Ltd. 1938. 7s. 6d. **15**

The facts recorded are based entirely on practice and results obtained in Great Britain. The work, which is in fourteen chapters and covers the whole range of conservation, hay, silage and artificial drying, has been written for the farmer and general reader interested in agriculture. Chapter headings include: haymaking and artificial drying, the nutritive value of hay, silage and dried crops, the relation of conservation to permanent grassland and its management, and forage crops for conservation. There are four appendices, one of which contains a tabulation of typical values (digestible crude protein, protein equivalent and starch equivalent) for the most important conservation products of the farm. A general index covers pages 185-92.

WATSON, S. J. **The science and practice of conservation: grass and forage crops.** Vols. 1 and 2. With a foreword by J. A. S. Watson. 25 × 15. pp. xi + 415; vii + 417-820. London: "The Fertiliser and Feeding Stuffs Journal." [1939.] Price for the two volumes, 30s. **16**

(1) This first volume is in fourteen chapters. It is built round work carried out at Jealott's Hill but is extended to cover investigations on the conservation of forage crops and crop residues made in all parts of the world. The importance of the subject is stressed in the foreword by Professor J. A. Scott Watson who maintains that, in devising methods for the conservation of grass and other forage crops harvested at an early stage of growth, when their nutritive value is still high, lies the solution to the problem of decreasing dependence on imported feeding stuffs.

In addition to the chemistry and bacteriology of conservation, aspects discussed include: crops for conservation, with special reference to stage of growth; the drying process, natural and

artificial, and losses involved ; the principles of silage making and processes employing physical or mechanical devices ; losses involved in silage making, and silage made from agricultural by-products and root crops. Conclusions drawn and bibliographies are appended to each chapter.

(2) The second part deals with the following aspects : nutritive value of hay, of artificially dried crops and silage, effects of conservation products on dairy produce and on sheep, horses and other stock, the relative value of different conservation products, and the place of conservation in agricultural practice. Subject and author indexes are supplied and there is an appendix on the capacity of silos.

C. GEOGRAPHICAL ASPECTS

SCOTTISH JOURNAL OF AGRICULTURE. AIV silage. *Scot. J. Agric.* 15. 252-61. 1932. **17**

WATSON, S. J. **Fodder preservation.** *Farming* 1. 83-7. 1947. [Edinburgh and E. Scot. Coll. Agric.] **18**

In this discussion of natural grass drying, artificial drying and ensilage, the need for preserving nutrients in winter feeds and for suitable management of grassland farms to ensure maximum returns is stressed.

WILL, W. J. **Silage making on a Dumfriesshire farm.** *Scot. J. Agric.* 28. 18-21. 1948. [The Farm, Crichton Royal, Dumfries] **19**

Practical hints for the production and utilization of pit silage are given. The pit, dug out of a bank, is 51 feet long, 15½ feet wide and on an average 10 feet deep. The soil surface has been lined with brick in the back and sides to overcome wastage caused by material being caught up in irregularities. Filling begins, according to the season and the crop, about late May or early June and continues at intervals until September. Loads are tipped on the top of the bank alongside the pit and filling is carried out by hand in the "long" state in preference to chopping and blowing. The whole area is kept level and molasses treatment applied evenly. Close attention is paid to temperature and one about 90 degrees F. is aimed at. No fixed rule applies to the period required for silage to reach its optimum temperature. Maturity of the crop is the controlling factor, but in general more time is allowed in the early stages of filling than later on in the season when aftermath with strong clover stems is being handled.

Crops ensiled comprise young grass cut about 8-12 inches in height, followed by arable silage consisting of a mixture of 1.5 cwt. oats and 35 lb. Maple peas. This crop is cut when the peas come into flower and the oats are just beginning to shoot.

Cattle of all ages are fed on the silage, from calves 4 months old to the dairy herd, in amounts varying from 4 lb. to 30 lb. per head per day. Dairy cows receive a standard allowance of 30 lb. per head from early December until the end of April, this replacing 1.5 lb. of the concentrate production ration fed during the winter months.

Brief notes are also given on marrow stem kale silage and maize silage and some of the disadvantages associated with the tower silo.

WILSON, A. S. B. **Ensilage.** *Trans. Highl. agric. Soc. Scot.* 53. 49-69. 1941. [Boghall Expt. Farm, Edinburgh.] **20**

WRIGHT, N. C. **The importance of home-produced feeding-stuffs. With special reference to the conservation of grass.** *Trans. Highl. agric. Soc. Scot.* 50. 1-37. 1938. [Hannah Dairy Res. Inst.] **21**

DREW, J. P. **Silage experiments at Albert Agricultural College.** *J. Dep. Lands Agric., Dubl.* 25. 290-6. 1925. **22**

DREW, J. P., and PYNE, G. T. **Losses in silage-making at the Albert Agricultural College.** *J. Dep. Lands Agric., Dubl.* 26. 208-14. 1926. **23**

DREW, J. P., O'SULLIVAN, G. F., and DEASY, D. **Grass silage.** *J. Dept. Agric. Irish Free St.* 33. 1-22. 1935. **24**

" The general principles of grass silage production are outlined. Attention is directed to the losses of nutritive material which may be incurred during the ensiling process and to the methods recommended for their minimization. The production of grass silage in different types of silo and by different methods is described in detail and discussed." The suitability of grass containing a high proportion of leafy material for ensiling by the acid methods is noted, but it is concluded that the production of grass silage by the natural fermentation method is the most convenient and economical when the grass is cut at the stage of growth in which it may be easily manipulated by machinery. The results of extensive experiments would appear to suggest that little commercial advantage is obtained by the use of the AIV process, or of the hydrochloric acid or Defu solutions.

MOORE, T. **Meadow grass silage on County Fermanagh farms.** *J. Brit. Grassl. Soc.* 2. 11-29. 1947. [Dept. Agric., Northern Ireland] **25**

The making of molassed grass silage on small farms in an area of cold, stiff clay soil where rainfall is high has been studied, the material being meadow grass in the pre-hay stage. There is ample evidence that such material can be ensiled in a suitable type of simple silo without any appreciable waste under ordinary farm conditions in County Fermanagh. Ensiling of natural herbage, however, under such conditions is not considered to offer any advantages over haymaking as a method of conservation except where side and top waste is satisfactorily controlled and labour costs for filling the silo are reduced to a minimum.

MOORE, T. **Silage making in Northern Ireland.** *J. Minist. Agric.* 54. 532-5. 1948. [Min. Agric., N. Ireland] **26**

Details are supplied of a case where silage was made from an arable crop in a simple pit. The seed mixture used was: 6 stones* oats ; 4 stones rye ; 2 stones maple peas ; 1 stone Italian ryegrass, per statute acre. The ryegrass and rye were included to ensure a heavy crop of aftermath for grazing or for a second cut for silage. The pit was 34 feet long, 6 feet wide, and excavated in a dry bank ; it was not lined with concrete. The width at the bottom was 10 feet and at the top 12 feet, the floor sloping to one end where drainage was provided.

Filling, which was delayed by the hay harvest, commenced on August 1 and completed on August 14, about $\frac{3}{4}$ acre being cut and ensiled daily. The mass was consolidated with horses after each load was added. Molasses, diluted with water, was added at the rate of one gallon to each ton of herbage. The material was trampled by horses for about half an hour daily for several days after filling had been completed, the ensiled crop was then covered with about 2 inches of soil and a waterproof cover to exclude rain.

The pit was opened in November and the silage found to be excellent throughout. The legume content of the mixture was low and the crop relatively mature when ensiled. The crude protein content of the dry matter, 13.96 per cent, was rather low, and the pH of the silage was 4.23. The production of good silage from such material with practically no waste in the silo is attributed to the thorough consolidation with horses.

Of the cost for 7 acres, £67 3s. 6d. was the cost of producing the crop and £39 7s. 0d. the cost of making the silage. The cost per ton of silage shows : £1 9s. 9d. as the cost of producing the crop and 17s. 4d. as the cost of making silage.

ROBERTSON, G. S., DICKINSON, F., and HOUSTON, J. **Silage investigations.** *J. Minist. Agric. N. Ireland.* 1. 70-104. 1927. **27**

1. Silage and roots as farm crops.
2. The feeding value of silage for dairy cows and fattening bullocks.
3. Effect of fermentation in the silo on the feeding value.

BENDER, C. B. **An extension program in grassland farming.** *J. Dairy Sci.* 21. p. 135. 1938. **28**

GARNER, F. H. **Recent developments in silage making.** *J. R. agric. Soc.* 103. 161-6. 1942. [County Hall, Ipswich] **29**

* 1 stone = 14 lb.

JOHNSTONE, W. **A review of silage.** *Vet. Record.* 60. 25-6. 1948. [Imp. Chem. Ind. Ltd.] **30**

The review covers the following aspects: grassland productivity, conservation methods, ensiling, suitable crops for silage (grass, arable crops and lucerne mixtures), mechanics of ensilage, and feeding. The following comparison of feed values is included:

	Starch equiv.	Digest. crude protein	Carotene
Fresh grass	100	100	100
Dried grass	95	95	80
Grass silage	75	90	85
Ordinary hay	55	65	10

ENGLAND AND WALES, MINISTRY OF AGRICULTURE AND FISHERIES. Bull. 37. **Ensilage.** By *A. Amos* and *H. E. Woodman.* 1934. pp. 53. **31**

ENGLAND AND WALES, MINISTRY OF AGRICULTURE AND FISHERIES. Bull. 37. **Ensilage.** By *H. E. Woodman* and *A. Amos.* 1938. pp. 71. **32**

This new edition brings the information on the latest methods of silage making up to date. (See Abstract No. 7).

PEEL, W. R., and WATSON, S. J. **The making of high-quality silage.** *J. Minist. Agric.* 46. 712-4. 1940. **33**

SANDERS, H. G., and GARNER, F. H. **The place of silage in British agriculture.** *Pap. 3rd Oxford Fmg. Conf.* 1938. pp. 75-80. [discussion, 103-8.] [Sch. Agric., Cambridge.] **34**

DAVIES, R. O., and ASHTON, W. M. **The making and feeding of silage in mid-Wales.** *Welsh J. Agric.* 17. 91-5. 1943. [Univ. Coll., Aberystwyth.] **35**

The production of silage, which was rare in Wales prior to 1939, is now becoming increasingly more general. This progress is likely to continue as the circle of farmers with successful experience of the making of silage and its utilization extends. The use of small silos of up to 20 tons content is a feature. Deterioration and waste of silage are due to (a) absence of sufficient all-over consolidation, (b) the crops ensiled being in too mature a condition, and (c) the failure to prevent the entry of rain into the silo.

Data are given on the maximum, minimum and average pH values; the percentage dry matter and crude protein for grass, grass + clover, cereal and also cereal + legume ensiling crops. The

feeding value of silage for milk production is shown to depend very largely on the type of material placed in the silo, and figures are given showing, for the different types of silage examined, the quantities necessary to produce one gallon of milk.

McLEAN, W. **The present position of silage-making.** *Agric. Progr.* 18. 39-42. 1943. [Univ. Coll. N. Wales, Bangor.] **36**

There is discussion of the value of young grass for silage and some results of the National Silage Campaign during 1940, 1941 and 1942. Data necessary for the assessment of the silage position and measures required for the ensiling of forage crops such as the oat, vetch and/or pea are noted.

ROBERTS, E. J. **Silage investigations at Bangor.** *Welsh J. Agric.* 2. 163-8. 1926. **37**

THOMAS, W. J. **Silage costs on Welsh farms, 1941.** *Welsh J. Agric.* 17. 15-21. 1943. [Univ. Coll., Aberystwyth.] **38**

Data on the cost of making silage were collected from 51 farms during the summer of 1940. Such costs were charged under the following heads : (a) rent of field ; (b) cultivations and seeds ; (c) fertilizers and manure ; (d) cutting, carting and ensiling ; (e) capital charges. In Wales the best silage at the lowest cost will probably be obtained from the herbage of young grassland. The cost per ton of grass silage was 19s. 2d., and of cereal-legume silage 29s. 5d. (See also *Herb. Abstr.* 12. Suppl. p. S59. 1942.)

EHRENBERG, P. [**Silage and ensilage and their relation to grassland utilization.**] *Mitt. dtsch. LandwGes.* 39. 743-50. 1924. **39**

FUCHS, K. Massnahmen von Regierung und Reichsnährstand zur Förderung des Futterbaues und der Gärfutterbereitung. [**The Government's and Reichsnahrstand's measures for the promotion of forage crop production and ensilage.**] *Futterb. GärfBereitg.* No. 2. 81-7. 1938. [Berlin.] **40**

An outline of the financial assistance obtainable by farmers and of the conditions under which it is given is preceded by a brief historical review of forage crop and grassland improvement in Germany. Money grants may be obtained for the following purposes : (1) the building of silos (up to RM. 1,000 per farm, the silo to be of concrete, stone, brick, iron, or watertight, strong wood) ; (2) the ploughing up or fencing of grassland (up to RM. 100 per hectare) ; (3) the conversion of unprofitable arable land into grassland (this applies to localities at an altitude of 400 to 900 metres only ; up to RM. 160 per hectare) ; (4) the steaming of potatoes for ensilage (25 per cent of the cost of a steamer, to be communal

property); (5) the washing of beet and turnip tops (30 per cent of the cost of washing apparatus, to be communal property); (6) artificial grass-drying plant (grant in accordance with the size and performance of the drier, up to 50 per cent of the cost). In addition, certain grassland improvement apparatus such as disk harrows, rollers, etc., is available for the use of smallholders The grants for silo erection have already resulted in an enormous increase in the number of silos in use.

GERMANY, Reichsnährstand und Forschungsdienst. Futterbau und Gärfutterbereitung. [**Fodder production and ensilage.**] No. 1. 24 × 17. Berlin: Reichsnährstand VerlagsGes. m. b. H. 1937. **41**

The first number of this periodical contained articles by F. Koenig (Versuchswirtschaft Steinach) on ways of increasing the productivity of permanent grassland; W. Nicolaisen and W. Seelbach (Inst. f. Futterbau, Kiel) on the effect of the time of cutting the "Landsberg mixture" [*Vicia villosa, Trifolium incarnatum* and *Lolium italicum*, a winter catch crop widely used in Germany] upon its chemical composition and yield; R. Geith (Betriebsw. Forschungsst. f. Grünlandwirtschaft, Leipzig) on the uniform interpretation of pasture manurial trials; and three articles by W. Kirsch (Tierzucht Inst., Univ. Königsberg), H. Schmalfuss and H. Werner (Hamburg), and L. Sperling (Tierzucht Inst., Univ. Königsberg) respectively, upon various aspects of the ensilage question.

SCHMIDT, K. Fünf Jahre Silagefütterung auf dem Versuchsgut Haiming. [**Five years silage feeding on the Haiming Experimental Farm.**] *Biederm. Zbl. B. Tierernähr.* 6. 481-97. 1934. **42**

The decrease in milk yield on September pasture, continuing on stall feeding with roots and hay, could be obviated by replacing the roots with good ensiled grass. By supplementing pasture with clover or vetch mixture and by subsequent stable feeding on good silage the milk yield could be maintained at high pasture level for a long time. The system described enabled older cows to yield about 250 kg. of 4 per cent milk more than previously obtained on beets and hay. The desired dry period of 40-50 days could easily be arranged by opportune deprivation of silage. [N. A. and R.]

VIRTANEN, A. I. Konservace píce ve Finsku a výroba mlēka na podkladě statkových krmiv. [**Fodder conservation in Finland and milk production based on home-grown fodder.**] *Vestn. Čsl. Akad. Zeměd.* 12. 455-61. [German summary, 461.] 1936. **43**

In a lecture delivered to the Czechoslovakian Academy of Agriculture, Prague, in May, 1936, the author summarizes the principles of the AIV silage process and reports on the results of feeding trials which have demonstrated the fodder's high nutritive

value. AIV silage may be made in ordinary pit silos covered with boards. In connexion with the ensilage question the author also refers briefly to his studies of nodule bacteria in the Leguminosae and their utilization in mixed cultures. A bibliography on both subjects is appended.

CHMELAŘ, F. Novější zkušensoti v pěstování silázních rostlin. [**Recent experiences in growing crops for ensilage.**] *Časové Otáz. Zeměd.* 1936. No. 56. 115-22. [Seed Testing Sta., Inst. Agric. Res., Brno.] **44**

During the 20 years preceding this article, the number of plants for ensilage has steadily grown. Maize is the most important of plants furnishing mainly carbohydrates. According to the new method it is cultivated in rows 50 to 60 cm. wide and sown thinner (60 to 100 kg. seed per hectare) to develop more and riper ears. In higher localities sunflower, cattle kale, tops of sugar and forage beet furnish good ensilage. Legumes are the source of protein. Of these horse beans furnish a high yield and in mixture with other plants a palatable ensilage. Both winter and spring cereal/vetch mixtures make good ensilage. Soybeans (especially variety 141 from Bratislava) pure or in mixture with maize give good yields in warm conditions. Coumarin-free sweet clover and sweet lupin promise good results but more productive varieties of these plants should be selected.

NEUGEBAUER, A. Silofragen. [**Silo problems.**] *Landw. Fachpr. Tschechosl.* 14. 213-4. 1936. [Barzdorf.] **45**

In perfect ensilage 10 per cent of the starch units are lost but practically no losses occur in the nitrogen content. This shows the economic importance of ensilage. For successful conservation air-tightness, temperature below 30°C. and a suitable substratum for lactic fermentation are essential. As building of silos in Moravia is rather expensive the establishment of concrete pits with a 30 to 40 cm. clay cover is recommended. Instructions on filling and addition of acids or sugars are given.

POLOWICZ, M. St. Kiszonki i metody ich przygotowania. [**Ensilage and methods for its preparation.**] *Gaz. roln.* 75. 191-2. 252-3 and 396-8. 1935.

GAZETA ROLNICZA. Kiszonki i metody ich przygotowania. [**Ensilage and methods for its preparation.**] *Gaz. roln.* 75. 301-4. 1935. **46**

(1) In a paper read to the Polish Farmers' Association (Zwiazek Rolników) in Warsaw in December, 1934, the author mentioned many important points relating to ensilage. A practical example of the effect of ensilage in increasing the net return in a

dairy farm was quoted. A great drawback is the different evaluations as to nutrient content attributed by various authors to this fodder. The necessity for a high degree of cleanliness of the material to be ensiled was stressed, and the importance of additions of acids (including the AIV method) discussed. In conclusion, the author considered the relative merits of different kinds of silos and maintained that the small ground silos are more suitable for Polish farmers than the frequently recommended high tower silos.

Some information which adds to the points raised in the discussion following the above paper is given. There is a growing interest among farmers in ensilage. Figures are available to show that the loss of nutrients in ensilage is very low. The author believes that the best results may be obtained with cold fermentation (15-25°C.); ensilage should be prepared without salt. Fresh and ensiled fodder are of the same value for dairy cows, while the quality of the milk for silage-fed cows may be very good, even for children (literature cited).

(2) *Gazeta Rolnicza.* In this anonymous article the discussion following the lecture by Polowicz, delivered to the meeting of the Polish Farmers' Association, is reported. Some of the points noted are (1) means of chemical conservation, (2) the construction of simple and cheap soil silos, (3) the addition of salt to ensiled material, (4) the importance of ensiling in dry seasons, (5) the effect of ensilage on quality of milk, and (6) loss of nutrients in various ensilage methods.

KOVÁTSITS, L. A korszerü magyar silógazdálkosás. [**Ensilage on modern lines in Hungary.**] Magyaróvár: published by the author. 1934. pp. 168. **47**

The making of silage by the hot and cold processes is dealt with at length, with special reference to the Hungarian climate and conditions of production. Ensilage in accordance with these conditions is elucidated by means of data obtained by the author in Hungary. The rational construction of silos, and methods of ensiling the crops which may profitably be used for the purpose in Hungary, are presented in popular form for the farmer.

KOVÁTSITS, L. A magyar silogazdálkodás legfontosabb takarmánynovényei. [**The principal silage crops in Hungary.**] *Köztelek.* 44. 162. 1934. **48**

The adaptation of the practice of ensilage to the arid climatic conditions of Hungary.

ALEMANNI, N. M. Foraggere e sili nella colonizzazione del latifondo siciliano. [**Forage plants and silos in the colonization of the Sicilian estate (latifondo).**] *Ital. agric.* 79. 71-7. 1942. **49**

ARNAUDI, C. **New aspects, theoretical and practical, of forage ensilage.** *Mon. Bull. Agric. Sci. Pract.* 31. 371-81. 1940. [Inst. Agric. Tech., Microbiol., Royal Univ. Milan] **50**

The experiments carried out at the Experiment Station of Agricultural Bacteriology at Crema, Italy, are described.

ROSSONI. Per l'insilamento dei foraggi. [**The ensiling of fodder.**] *Riv. coniglic.* 11. No. 3. 12-14. 1939. **51**

ESCAURIAZA y del VALLE, R. de, and TENREIRO, F. L. Ensayos del método de ensilaje A.I.V. en Galicia. [**Trials of the AIV ensilage process in Galicia.**] *Bol. Inst. Invest. agron., Madrid.* No. 7. 177-99. [English summary, 197.] 1942. [Estación de Praticultura y Cultivos de Vega, La Coruña, Galicia, Spain.] **52**

Construction was begun in 1935 but the silos were not ready till 1940, and experiments begun in 1941 were limited to the use of hydrochloric acid. The material was vetch-oats mixture, meadow grass, and *Trifolium pratense*. Technique is described. The results were satisfactory, and the process is recommended for the north and north-west of Spain, for which purpose simplified trench silos are recommended.

SALCEDO, L. F. Diálogo del maiz ensilado. [**Dialogue on the ensilage of maize.**] *Surco, Madrid.* 3. No. 34. 22-3. 1944. 4. No. 35. 18-9. No. 36. 18-20. 1945. **53**

An exposition of the principles, practice and uses of ensilage, with special reference to maize. The variety Caragua is particularly recommended for ensilage purposes, and as seed is difficult to obtain, growers are advised to reserve approximately 3 per cent of their maize area for seed production.

KARAULOVA, A. [**The management of the principal silage crops. Directions of the U.S.S.R. Inst. for Fodder and Grassland Research.**] *Za Kormovuyu Bazu.* 2. No. 3. 44-6. 1932. **54**

The Section on ensilage of the conference held at the Kachalkino Institute on 16-21 February, 1932, elaborated general instructions as to the technique of ensilaging. Cultures include (1) special crops (lucerne, clover, *Onobrychis*, maize, sunflower, sorghum, *Lupinus*, and other legumes and grasses), (2) weeds, wild-growing herbs and marshy plants, (3) by-products of gardening and horticulture, (4) threshing remains, (5) young branches and leaves of trees, other than those of conifers and oaks. These instructions will appear in this Journal. This article, which is one of the first of the series, deals with technical problems such as preparation of soil, manuring, date, rate and depth of sowing, management and treatment, harvesting, etc., with special reference to the application of agricultural machinery in maize, sunflower and sorghum cultivation.

Moscow, U.S.S.R. Institute of Fodders. [**Forage technology.**] [Edited by] V. V. Lebedev. 1934. pp. 320. **55**

This publication, which is in two parts (dealing respectively with ensilage and preparation of fodders), is primarily of animal nutrition interest.

Aikkinen, I. AIV-instruktion under två års tid—resultat. [**AIV-instruction during a period of 2 years—results.**] *Tidskr. Lantm.* Vol. 29. p. 54. 1947. **56**

In Finland's supplementary budget for 1945 a grant of 6 million marks was made for instruction of small farmers in the cultivation of forage crops and in the preparation of AIV silage. The country was divided into eighty (now seventy) areas and advisers were appointed in April, 1945. Work was concentrated on small farms and results are shown by the figures relating to consumption of AIV liquid, which increased from 3,429,473 kg. in 1944 to 6,047,815 kg. in 1946. In 1946 preparations were made for the building of 4546 silos of which 2042 were completed and 1721 in course of construction. In 1947 an effort is to be made to build 7000 new tower silos. Instruction in forage crop cultivation has not yet been begun, but it is hoped to initiate this branch of the service in the current year.

Poijärvi, I. AIV-metoden och dess betydelse för vår självförsörjning under handelsavspärrningen. [**The AIV method and its importance for Finland's provision of home-produced fodder during the blockade.**] *Nord. JordbrForskn.* 22. 205-17. 1940. **57**

In Finland there has been an inevitable and serious decline in the production of milk and eggs owing to the lack of imported concentrated feeding stuffs. The effort made to check this decline has to a great extent proved successful. As approximately 45 per cent of the arable area in Finland consists of hay leys, the most important of the means adopted are those designed to increase the yield from these grassland areas. The results obtained with different methods of harvesting are compared and the advantages of the AIV method are stressed.

Virtanen, A. I. Riktlinjer för självförsörjande kvävehushållning i lantbruket. [**A guide to self-supporting nitrogen economy in agriculture.**] *K. LandtbrAkad. Handl. Stockh.* 74. 609-44. 1935. **58**

An account is given of the methods, based on a self-supporting nitrogen economy, which are now being utilized in Finland to reduce production costs of milk and increase the remunerativeness of farming. The author points out that by the AIV method of silage preparation the production of fodder necessary for winter feeding can in all circumstances be obtained in the cheapest way.

VIRTANEN, A. I. [**Feeding with home-grown fodder based on AIV.**] *Lantm. Svenskt Land* 24. 485-6. 1940. **59**

A description is given of cattle feeding based on AIV fodder conducted since 1933 on the author's farm in South Nyland, Finland. The basic principle has been that nitrogen has not been purchased in any form, neither concentrated fodder rich in protein nor nitrogenous fertilizers. AIV feeding at the farm in question since 1933 has clearly demonstrated that AIV fodder has no harmful effect on the health of the animals. [N. A. and R.]

VIRTANEN, A. I. Mekanisering av AIV-foderberedningen. [**Mechanization of AIV fodder preparation.**] *Lantm. Svenskt Land* 26. 744-5. 1942. **60**

After the war the work of reconstruction in Finland and in other belligerent countries will make such demands on all available labour that on this account it is necessary in good time to plan possibilities for rationalization of work in agriculture. This applies in particular to cattle tending, in which branch of farming very little attention has been paid up to the present to rationalization. One should both in fodder production and in laying down of fodder as in pasture farming aim at more labour-saving methods.

Ley cultivation, compared with the growing of annual forage crops, is highly labour-saving. Hay curing makes great demands on labour as it has to be carried out in a short time. The preparation of AIV fodder, however, extends the period of harvesting of the leys. The ley harvest falls during the middle of June and during the latter half of July before the corn harvest, thus at two points of time when there is no other urgent agricultural work on hand. Laying down of tops and aftergrowth for AIV fodder in the autumn can be fitted in on rainy days, and need then not increase the labour requirement appreciably.

The preparation of AIV fodder presents greater possibilities for rationalization than hay curing. On large farms specially constructed elevator mowing machines can be employed. Feeding of the green fodder into the receptacle takes place by means of a fan and the acid is applied at the same time by means of a rubber tube in doing which only one man is required in the receptacle. The gang consisting of tractor driver, carters, and a man for the container can in one day put down many tens of tons of AIV fodder. On small farms these methods cannot be used, but here too the laying down of fodder can be facilitated by certain simple arrangements.

It is important that the fodder containers should be suitable both from the point of view of fodder conservation and of labour, and that their position should be chosen with care to economize transport.

VIRTANEN, A. I., TUORILA, P., VALLE, O., SALMINEN, M., AIKKINEN, I., and JÄNTTI, A. Rehunviljelysopas AIV-rehun valmistajia varten. [**Guide to fodder cultivation for farmers making AIV silage.**] 1947. pp. 176. **61**

Within recent years approximately eighty advisers have been working on the subject of AIV ensilage in Finland. As it has been necessary to intensify the growing of forage crops so as to increase yields and to improve their quality, the above-named book has been published by Finnish experts in different fields.

Virtanen (pp. 5-20) treats the importance of forage crop production and especially of leys for animal production. By means of the AIV process it is possible to produce more protein and a more valuable feeding stuff for the long periods between grazing seasons than by means of haymaking. *Tuorila* (pp. 21-41) stresses the importance of improving growth conditions. As approximately 80 per cent of Finland's arable land is in need of lime, very considerable increases in yield could be obtained, according to the results of trials an average of 30 per cent, by more abundant liming. Much larger quantities of commercial fertilizers should be used than before the war. There is, in particular, a great deficiency of phosphoric acid. *Valle* (pp. 42-107) deals first with the technique of ley cultivation on the basis of the results of experiments made in Finland in the 1930's and 1940's. In this the intensification of red clover growing is of primary importance. As the production of red clover seed has been inadequate from 1940 onwards, the first objective is the improvement of seed-growing technique with the aid of recent experimental data obtained in Finland. The commonest seeds mixture comprises *Trifolium pratense* and *Phleum pratense*, but instead of 4 to 5-year leys shorter 2 to 3-year leys should be grown, with a heavy stand of clover. The following is recommended as a normal mixture, in kg. per hectare: *Trifolium pratense*, 8; *T. hybridum*, 2; and *Phleum pratense*, 20. Red clover in a pure stand cannot be generally recommended, as it is often deficient in winter hardiness. Several experiments have been made to ascertain the connexion between the wintering of red clover and the time and method of harvesting in the late summer, from August to September. The best time to cut the aftermath is the end of August, as red clover can then have time to grow again before the cold period sets in. When cutting is done in September, the herbage must be left taller than is normally the case in order not to endanger wintering. By the growing of green forage crops (peas, vetch and oats) and the so-called midsummer rye (rye and green fodder mixture sown in June), material for AIV silage can also be ensured, and it is therefore of the greatest importance to conduct trials of annual forage plants. *Salminen* (pp. 108-135) discusses the value of growing potatoes and roots. Potatoes have given much higher and more reliable yields

in Finland than turnips, swedes, and fodder beet or mangels. For this reason, they have been increasingly cultivated for fodder as well as for food from the 1930's onwards. By rationalizing cultural technique it would be possible to increase potato yield still more and to reduce the costs of production. *Aikkinen* (pp. 136-143) deals with the importance of intensive fodder growing by means of a cropping system such as: barley, clover-timothy, (2 years) spring wheat, roots and potatoes. The rotation should be planned in fields close to the farm buildings. *Jäntti* (pp. 144-176) stresses the great significance of the pastures during the growing season for ensuring animal feed. His findings are based on his research into the relative value of the different types of Finnish pastures. In the field of pasture management, also, more intensive technique is being adopted.

SPILDO, L. S. Resultatene av konservering av for efter AIV-metoden i Norge. [**Conservation of foodstuffs by the AIV method in Norway.**] *Nord. JordbrForskn. Kongresberetn* 1935. 752-62. **62**

Losses in conservation by the AIV method were investigated in 6 trials, and were found to vary from 10 to 30 per cent. Loss of organic substance amounted to only 3 per cent, and that of total protein to 4.6 per cent. No injurious fermentation took place, and the acidity of the silage was below pH 4. In cases where the pH was 4.2 or more, the plants were visibly decomposed during the conservation, and butyric acid and ammonia were formed, which reduced the nutritive value of the silage. [From N. A and R.]

SPILDO, L. S. Futterkonservierung nach dem AIV-Verfahren. [**Fodder conservation by the AIV method.**] *Rep. 3rd Grassl. Conf. Zürich.* 1934. 398-405. [English summary, 405.] [Oslo, Norway.] **63**

Good results are reported from trials with this method in Norway, as regards the practical merits of the method, the palatability of the fodder and its effect on the quality of dairy products.

EDIN, H., BERGLUND, N., and ANDERSSON, Y. Undersökningor angåerde grönfoder samt metoderna för dess konservering. [**Investigations regarding green fodder and the methods of preserving it.**] *Medd. CentAnst. Försöksv. Jordbr.* Pt. 2. No. 431. 1933. **64**

GIÖBEL, G. Vallodlingens utveklingsmöjligheter. [**Possibilities of development of ley cultivation.**] *Nord. JordbrForskn.* 1944. No 2. pp. 116-25. **65**

If cattle farming in Sweden is conducted in future on the same scale as before the war, it will be necessary to produce as much good-

quality fodder on the leys and also to reduce the cost of fodder production. The cheapest and best fodder is obtained on well-managed cultivated pastures: the cost of production of a fodder unit of pasture is only about half that of a fodder unit of hay. Next in importance is the improvement of hay and silage by raising the protein content and the degree of concentration. More and better hay and silage can be produced by extending the area of ley cultivation and by increasing production per unit area by means of plant breeding, by selection of strains suited to the locality, by manuring, and, further, by improved methods of harvesting. The need for well-regulated seed production together with careful cleaning and control of seed is emphasized. Inoculation of clover seed should be more widely practised, particularly in Norrland.

In Central Sweden a more general transition from 3-year to 2-year leys, and in Norrland from long-duration grass leys to 3 to 4-year clover-timothy leys is to be recommended. In the south and central parts of the country lucerne leys yield excellent fodder; this plant is well suited for cultivation in the eastern provinces where protracted summer drought commonly prevails.

Hay and silage of good quality are obtained with early cutting, when clover is still in the bud stage and timothy is coming into panicle. Curing hay on hurdles gives the best results. A considerable saving of labour is effected by the use of the "cut-lift" machines of the English type. The problem of artificial drying has been solved, but it remains to make it economically suitable for practical agriculture. The preparation of AIV silage has made great headway, but a much more general use of this method is desirable and should be possible as soon as the price of the requisite acid can be reduced.

KLEIST, C. A. AIV-foderberedning—en viktig åtgärd för vår foderförsörjning. [**The preparation of AIV fodder—an important measure for providing Sweden with fodder.**] *Lantm. Svenskt Land* 27. 522-3. 1943. **66**

By feeding stock with AIV fodder, winter milk has as high a vitamin content as summer milk, and Swedish farmers can maintain milk production at a high level without importing costly concentrated fodders.

KLEIST, C. A. Erfarenheter från fältarbetet i AIV-propaganda. [**Experiences from field work in AIV propaganda.**] *Sverig. Utsädesfören. Tidskr.* 54. 270-8. 1944. **67**

An account is given of farmers' opinion regarding AIV fodder. Methods of obtaining material for ensiling are described. In a comparative feeding trial at Ultuna the cost of fodder per kg. milk was 2.3 öre less, due to inclusion of AIV fodder in the ration. There

has been in Sweden an increase of approximately 500,000 tons green mass for conservation as AIV fodder : this amount corresponds to 13,000 tons concentrated feeding stuffs. The increased production of 75 million kg. milk means for Swedish agriculture an additional income of about 15 million kronor.

LAUDON, A. Foderutbytet vid konservering av vallväxter. [**Yield of fodder in conservation of meadow plants.**] *Lantm. Svenskt Land* 26. 462-4. 1942. **68**

Owing to the wartime blockade and the poor harvests during the last few years, the question of improving the quality of home produced feeding stuffs has become a very urgent one in Sweden.

The younger the plants are, the higher is their content of minerals and protein. Also the total crop yield in food units, digestible protein and concentrated food units is higher the earlier cutting is carried out. Thus in trials with clover at Offer from 1931 to 1934, the yield expressed in relative figures was respectively 184, 143 and 100 with an early, medium-early and late first cut.

The losses with different methods of conservation vary considerably. With artificial drying of tender meadow plants practically all the nutrient content of the green mass is retained. The preparation of AIV fodder is also good with a loss of 20 per cent of the food unit content of the green mass. Drying in cocks with a loss of 33 per cent is a method which should not be used ; it should be replaced by drying on frames (loss 25 per cent). The cost of the increased yield with drying on frames is calculated at 2.8 öre per concentrated food unit. The increased yield with the preparation of AIV fodder in comparison with frame drying can be computed at 10-17 öre per concentrated food unit, for which reason the preparation of AIV fodder is to be considered superior to frame drying. Artificial drying is in certain cases more economic than the other methods of conservation (increased cost per concentrated food unit in comparison with frame drying 18.5-32 öre). Frame drying, the preparation of AIV fodder and artificial drying must, however, not compete, but must supplement one another.

Artificially dried fodder has a greatly increased value in its high content of vitamin A. Lucerne meal contains carotene corresponding to approximately 200 IE. vitamin A, and this vitamin costs only about one-third of the vitamin in fodder whale oil.

WENNERSTRÖM, B. Inför sommarens AIV-foderkampanj. [**On the eve of AIV-fodder campaign in the summer of 1942.**] *Lantm. Svenskt Land.* 26. 495-6. 1942. **69**

During the last ten years the preparation of AIV fodder has increased steadily. In 1932 the amount of green mass so converted was 19,000 tons, in 1939 it had increased to 70,000 tons, while during

the last two years, in spite of the sparse supply of green mass, this amount was more than doubled. Thus in 1941 the amount of green mass was 157,800 tons. This fodder has been of the greatest importance for milk production on individual farms. In its entirety however the AIV fodder laid down constitutes only 1 per cent of the total yield from the leys. The previously imported oil concentrated fodder made up approximately 300 million food units and to replace this it would be desirable for the putting down of AIV fodder to be increased to comprise about 10 per cent of the hay crop, which normally would correspond to 200 million food units.

To provide further information about AIV fodder the county agricultural societies in collaboration with the society "Mjölkpropaganda" have arranged courses in silo construction and in the putting down of AIV fodder. In south and central Sweden ready-made silos can be bought. Leaflets dealing with these questions are also published by the Food Committee.

To increase the amount of material to be converted into AIV fodder, farmers are recommended *inter alia* to sow legume-rich green fodder and also to grow more lucerne. On poor soils in south Sweden sweet lupin is being increasingly grown. Late-sown white mustard when cut early has yielded good AIV fodder. In recent years potato tops have also been ensiled with good results.

Both cement and wooden silos should be impregnated. Owing to the scarcity of impregnating material, with wooden silos an external protective coating of the undersilo is sufficient. For the more expensive tower silos, however, a complete impregnation is considered necessary.

LIDHOLM, I. AIV-inläggning i Norrland. Synpunkter och erfarenheter. [**Laying down of AIV fodder in Norrland. Points of view and results.**] *Svenska Vall- o. MosskFören. Kvartalsskr.* 3 171-210. [German summary, 208-9.] 1941. **70**

Fundamentally a distinction can be drawn between two very old but essentially different forms of storing of winter fodder, firstly, where the plant material is dead and dried, and secondly, where storage is carried out without a previous intentional reduction of the moisture content, when the fodder during a long period remains alive. An example of the former method is hay curing, and of the latter, the laying down of roots, etc. in clamps. The preparation of silage is a modification of the second method.

At the present time when practically no concentrated feeding stuffs are being imported into Sweden, AIV fodder occupies a very prominent position. A detailed description, illustrated by photographs, is given of the construction of pit and surface silos, including the "snow houses" used in Norrland, and of the method of laying down the AIV fodder.

Owing to the serious drought in the spring of 1940 no aftermath was available, on which account in accordance with the Finnish practice potato tops were converted into AIV fodder. On the very small farms in the north of Sweden, in order to fill the silos it was necessary to use different kinds of material. Thus the kind of fodder which requires the largest amount of acid was placed at the bottom of the silo, on which a different type of fodder with a smaller requirement of acid was laid and so on. A suitable sequence is for example: 1. Layer of leaves (top layer). 2. Turnip tops. 3. Sedge, horsetail, or meadow grass. 4. Green fodder barley or green fodder oats. 5. Aftermath of clover and timothy. 6. Potato tops (bottom layer). Both AIV.-ensiled potato tops as well as "layered AIV fodder" proved to be valuable in practice and were readily eaten by cattle.

DAHLSTEDT, L. AIV-foderberedning i Norrland. [**The preparation of AIV fodder in Norrland.**] *Lantm. Svenskt Land* 29. 571-2. 1945. **71**

Experiences are described on a seter in Västernorrland where since 1939 varying amounts of AIV fodder have been prepared with material from the spring's surplus pasture, from the first-year hay leys and also with marrow stem kale. The AIV method has made great headway in Norrland, but its use might be further extended. The crops from the Norrland hay leys are so large that they cannot be utilized in a rational manner in the byres for feeding in the form of hay exclusively. The adoption of this method would show farmers the disadvantages of the long-duration hay leys, many of which are so old that they give a very small yield and are hotbeds of weeds.

WENNERSTRÖM, B. AIV-metoden på frammarsch. [**The AIV method is making headway.**] *Lantm. Svenskt Land* 29. 67-8. 1945. **72**

In 1944 the quantity of green mass ensiled was 295,000 tons or four times more than in 1939. The increase compared with 1943 was approximately 15 per cent. Calculated on the average per cow the amount of green mass put down during 1944 varied from about 25 kg. in two of the Norrland provinces to 630 kg. in Halland. For the whole country in 1944 the average per cow was only 170 kg. green mass for AIV silage. To ensure a supply of 10 kg. AIV fodder on the average per cow per day during 6 months stall feeding, it would be necessary to increase the preparation of AIV fodder by more than ten times the present amount.

ESKEDAL, H. W. Danske Forsøg med Konservering af Graesmarks- og Grønfoderafgrøder. [**Danish trials in the conservation of grassland and green fodder crops.**] *Nord. JordbrForskn.* 1935. No. 4-7. *Beret. Nord. JordbrForsk. 5. Kong.* pp. 725-33. **73**

Danish experiments in the conservation of grassland and green fodder crops during the period 1931-1935 are described. In Part 1 of the paper combined conservation and feeding experiments are dealt with ; in Part 2, digestibility experiments. The yield figures show that both hay and silage had a favourable effect on milk yield. Digestibility is greater in fresh *Trifolium pratense* than in both hay and silage. For organic dry matter the digestibility coefficient for AIV fodder is 73, while that for the corresponding clover is 79. The digestibility coefficient for hay is 66. The corresponding clover has a digestibility coefficient of 77. In other words the reduction in digestibility (organic dry matter) is 11 points from clover to hay and 6 points from clover to AIV fodder.

JENSEN, H. L., and STEENSBERG, V. Ensilering og ensilage. [**Ensiling and silage.**] *Kgl. danske LandhSelsk.* pp. 166. 1945. **74**

The theoretical account concerning methods of ensiling is to some extent based on investigations conducted abroad, while use has been made of Danish trials as regards the applicability of the ensiling methods and the fodder value of the silage.

The work comprises seven main sections dealing with the fundamental rules of ensiling, crops for ensiling, construction of silos, arrangement and carrying out of ensiling, fodder value of silage, use of silage, and effect of silage on the quality of milk and dairy products. A description is given of the various methods of ensiling.

LEEUWEN, A. van. Het Zuid-Hollandsche kuilgras. [**Grass silage in South Holland.**] *Maandbl. LandbVoorlDnst* 3. 182-91. 1946. [Animal Husbandry Advisory Service, South Holland, Netherlands] **75**

Reference is made to previous articles (see *Herb. Abstr* 16, Abs. 1178, 1179. 1946). During the war no silos could be built, and the so-called warm method of ensilage was that chiefly employed, in stacks or (less frequently) in trench silos or in built silos. Where the last-named were available, however, the AIV method or else ensilage with the aid of molasses were resorted to. Loss of nutrients is greatest in the warm method. The chemical composition of the warm-method product is discussed as affected by the following factors : the cover, its weight and nature (a heavy cover gives the best results, sand is better than earth) ; soil type (no clear effect) ; time of mowing (spring grass gives a rather better quality

silage than summer and autumn grass) ; type of silo. The AIV and molasses products are similarly discussed. The molasses method has given very satisfactory results in South Holland and other provinces.

NETHERLANDS, Directie van den Landbouw. LandbVoorlDnst. Med. No. 42. Onderzoekingen en ervaringen in verband met het inkuilen van gras en groenvoeders. [**Trials and experience in the ensilage of grass and green fodder.**] By *J. F. van Riemsdijk.* pp. 75. pls. 1946. [Centr. Inst. Landbouwk. Onderzoek, Wageningen] **76**

The following aspects of ensilage are discussed : processes taking place in ensiled material, quality, methods, losses, nutritive value, effect on animals and on dairy products, costs in comparison with other methods of conservation, and ensilage in the Netherlands. The percentage of grassland of which one cut was ensiled was less than 10 per cent of the total grassland area in 1942-43 and 1943-44, and of the grass used, three-quarters were taken from the second and later cuts. Five times as many trench silos as built silos were used. The amount of grass silage available per animal was on an average for the Netherlands 500 kg. in the winter of 1943-44, but in the province of Friesland, where ensilage is an old-established practice, it was 1000 kg. Chemical analysis showed silage made with the aid of AIV. preparation, molasses, or formic acid to be somewhat more valuable than that made by the old Frisian method, but for economic reasons the last-named is the most popular.

COOLS, L. La conservation des fourrages verts. [**Conservation of green fodder.**] *J. Agric. prat. Paris.* 98. 484-5, and 504-6. 1934. [Heverlé, Louvain, Belgium.] **77**

A report of the trial and application of the AIV method of conserving silage in Belgium.

PIRAUX, E., HACQUART, A., JOASSIN, F., and DESMET, F. Enquête sur l'ensilage des fourrages verts en Belgique. [**Investigations on green fodder ensilage in Belgium.**] *Bull. Inst. agron. Gembloux.* 4. 106-48. [German, Dutch and English summaries, 145-8.] 1935. [State Dairying Sta., Gembloux, Belgium.] **78**

Fifty-six ensilages composed of various mixtures of grasses, legumes, cereals and beet were made in several different ways, and various acids tested as to their effect on the preservation and quality of the material. The superiority of the method involving the addition of mineral acid to create an optimum pH value of 4.0 would appear to be proved. Ensilage in small silos without addition of acid gave more or less satisfactory results only when sugar was added. The tower silo gave good results with grass and maize,

while silage stacks gave variable results. Numerous related aspects of the question, including points more of interest to animal nutrition workers, are also discussed.

PIRAUX, E., JOASSIN, F., and COPPENS, R. L'ensilage des fourrages verts en Belgique. [**The ensilage of green fodder in Belgium.**] *Bull. Inst. agron. Gembloux.* 5. 112-52. [Flemish, English and German summaries, 150-2.] 1936. [Sta. Laitière de l'Etat, Gembloux, Belgium.] **79**

Thirty-three fodder crops of various sorts and twenty-seven silages made by different processes have been studied. It is concluded that the crops used must be young. Young grass of the first cut is to be preferred, so far as protein content and yield are concerned, to older grass of the first cut. Grass of the first cut can give a silage superior to that obtained from aftermath, and of a quality comparable with clover silage. A mixture of ryegrass and winter barley seems worthy of attention. The addition of mineral acid affords the highest guarantee for the preservation of proteins and digestibility ; sugar ensures good acidification, but causes a serious breakdown of proteins and a diminution of digestibility " in vitro " of true protein, though very little in that of crude protein. Other types of ensilage, with the exception of the hot fermentation process in a tower silo for maize, seem of little interest.

GRANDJEAN, S. AIV-Silage und Silobau. [**AIV silage and the construction of silos.**] 2nd. edn. Aarau : Wirz and Co. 1943. pp. 73. **80**

A handbook for the Swiss farmer.

LANDIS, J. Wirtschaftliche und technische Fragen der Dürrfutter- und Silagebereitung. [**Economic and technical questions in the preparation of dried fodder and silage.**] *Schweiz. landw. Mh.* 1937. No. 3. 69-86. **81**

The author concludes that under the conditions prevailing in Switzerland, modern methods of harvesting and preserving (drying on frames, artificial drying, ensiling) have resulted in no appreciable reduction in cost per unit of starch equivalent. Measures and possibilities for improvement in the future and for the organisation of the various methods in districts where milk is produced for consumption in the liquid state, in those where butter and cheese are produced and in the mountain districts, are discussed. [From N. A. and R.]

SCHNYDER, A., and KAUTER, A. Acker- und Futterbau. [**Arable farming and forage production.**] 2nd edn. 22 × 15. pp. 296. 1 col. map. Bern : Buchverlag Verbandsdruckerei A.G. 1945. 11s. 6d. [Solothurn (A.S.), and Eidg. Landw. Versuchsanst. Zürich-Oerlikon (A.K.)] **82**

A revised and enlarged edition of a textbook for agricultural colleges and a manual for the Swiss farmer. The first four sections, on seeds and seed production, the growing of cereals, oil and fibre plants, potatoes and other roots, are written by Schnyder, and the remaining section, on herbage and forage growing, by Kauter.

The section on forage production deals successively with general considerations, the principal herbage and forage plants, catch crop cultivation on arable land, temporary leys, natural grasslands, grassland weeds, insect and other pests, conservation (haymaking, ensilage, and grass drying). The chapter on temporary leys outlines their importance, the composition of mixtures and the principles governing it, establishment and management including manurial treatment, seed production and origin. For an outline of the chapter on catch crop cultivation see *Herb. Abstr.* 17. Abs. 140. The chapter on conservation includes a description of haymaking on frames.

HOSAIN, Malik Fazl. **Conservation of green fodder.** *Indian Fmg.* 6. 173-5. 1945. [Imp. Vet. Res. Inst., Izatnagar] **83**

Ensiling needs to be popularized by simple methods in India. Four pit methods of silage-making were studied, and molasses increased yield obtained. The tightly-packed silage lost only 10 per cent dry matter and retained essential nutrients. All pits were lined with dried *Saccharum spontaneum*. A pressure of 700 lb. maintained for 20 minutes on each 200 lb. of material added to a 5 feet square pit is recommended, together with molasses at the rate of 1 per cent of the green fodder weight.

INDIA, Central Provinces and Berar, Forest Dept. Bull. No. 3. (Revised September 1941). **Grass silage making. (A note for use by the public.)** By *V. K. Maitland*. Nagpur, 1941. pp. 7. **84**

An inexpensive and simple method of converting grass, available in plenty in the remoter forest, into silage is one of the steps taken by the Department for live-stock improvement. Details of the preparation of silo pits and of grass silage are supplied.

SIERRA LEONE. **Annual Report of the Department of Agriculture for the year** 1944. Freetown, 1945. pp. 15. [Received April, 1946] **85**

At the Njala Station experiments on upland pasture establishment and management are in progress to determine (1) the possible recuperation of degraded upland soil by rotational cattle grazing ; (2) the improvement of grassland for cattle feeding ; (3) the selection of improved grass varieties ; and (4) the productivity of pastures under rotational grazing.

Pit silage, using elephant grass, maize and *Andropogon*, both alone and mixed with *Pueraria* and *Calopogonium*, was made experimentally. All produced good silage, especially the mixtures. Good pit silage was made from *Andropogon tectorum* and may offer a solution to the dry-season feeding of stock.

FRENCH, M. H. **The place of silage in the dietary of live stock.** *E. Afr. agric. J.* 1. 241-3. 1935. **86**

FRENCH, M. H., and PURVIS, J. T. **Maize silage in East Africa : its preparation, quality and feeding value.** *E. Afr. agric. J.* 1. 229-32 and 235. 1935. **87**

Maize, cut by hand at the " milky " stage, was packed lengthwise in a pit 110′ long, 14.5′ wide and 8.5′ deep, the loaded wagons being used for pressing and consolidating, Layers of hay and soil served as a covering. When required for use the silage was sliced out from one end of the pit in lengths of about 9″. The silage was relished by all classes of stock. Tables showing its composition, digestibility and nutritive value are given. The nutritive losses by this method are no greater than with other accepted methods. [N. A. and R.]

MAHER, C. **Mixed farming in East Africa. II. Grassland and arable dairying in the Trans Nzoia district.** *E. Afr. agric. J.* 2. 12-27. 1936. [Agric. Officer, Kenya Colony.] **88**

The types of grassland occurring in the Trans Nzoia, a district of 1,155 square miles in the European area of Kenya Colony, are described and classified.

A number of grasses are enumerated of value for hay crops, silage and green fodder. *Eragrostis abyssinica*, *Panicum maximum* and *Panicum coloratum* may prove to be useful hay plants. For silage maize is recommended, while for green fodder, elephant grass (*Pennisetum purpureum*) and Sudan grass (*Andropogon sorghum* var. *sudanense*) are useful.

SOUTH AFRICA, Department of Agriculture. Bull. 7. **Silos and silage.** 1927. pp. 46. **89**

HENNING, P. D. **The latest methods of silage-making.** *Fmg. S. Afr.* 11. 199-201. 1936. [Dept. Field Husbandry, Stellenbosch-Elsenburg College.] **90**

HENNING, P. D. **Fodder conservation.** *Fmg. S. Afr.* 18. 149-57. 1943. [Stellenbosch-Elsenburg Coll. Agric.] **91**

A discussion on ensiling and haymaking.

ROUX, L. L., and STEAD, H. A. J. **Farming in the Cape Midlands.** *Fmg. S. Afr.* 19. 746-56. 1944. **92**

The geographical position, topography, rainfall and soil types of the region are described. The topography is typical of that of the Karoo and the plants grazed by stock are varied and widely separated due to scarcity of soil moisture. Lucerne is one of the principal crops grown in the area and is used for grazing, hay and ensiling. Wheat is grown as widely as lucerne, but much of the crop is grown under natural rainfall conditions, and some grazing is usually obtained during its early growth. More extensive growing of silage crops such as maize and sorghums is recommended where cattle are kept and greater use should be made of drought-resistant plants such as spineless cactus, saltbushes and fodder trees during periods of scarcity. Details are given of the systems of farming and the livestock population of the Cape Midlands.

SCHULTZ, W. **Methods of harvesting silage crops and filling of silos.** *Fmg. S. Afr.* 11. 286. 1936. [Sch. of Agric., Cedara, Natal.] **93**

The methods apply to maize, sorghums, *Andropogon sorghum* var. *sudanensis*, *Pennisetum purpureum*, legumes and various pasture grasses.

SOUTH AFRICA, Department of Agriculture and Forestry. Bull. No. 181. **Silage, silos, and silage crops.** *By I. J. Smuts.* 1938. pp. 51. pls. [Sch. of Agric., Glen, O.F.S.] **94**

The common silage crops are maize, sunflower, kaffir corn, sweet sorghum and pearl millet, Sudan grass, artichokes, cowpeas, soybeans, *Dolichos*, *Mucuna*, and *Medicago*. The relative merits and demerits of each and the conditions under which they should be grown are recorded.

NYASALAND AGRICULTURAL QUARTERLY JOURNAL. **Ensilage.** *Nyasaland Agric. Quart. J.* 1. 26-8. 1941. **95**

In most parts of the Protectorate where European agriculture is practised and herds of cattle maintained, several months of dry weather are experienced when the bush is burnt and grazing is scarce. Ensiling the bush grasses is recommended, and methods are noted.

CANADA, Department of Agriculture. Pub. 525. Farmers Bull. 13. **Silage production.** *By E. S. Hopkins and P. O. Ripley.* 1936. 79. **96**

An account is given of experiments conducted over a long period to determine the most suitable crops and methods for making silage. While corn is the most suitable crop, red clover, sweet

clover, alsike, oats, mixtures of oats, peas and vetches, barley, buckwheat, sunflower, alfalfa, timothy and roots were used with success. Methods of growing and harvesting crops for ensiling are described, emphasis being laid on the influence of the stage of maturity on the quality of the silage produced. The advantages and disadvantages of the acid treatment are discussed. Costs of crop production and ensiling are given and various types of silos described. The results of palatability tests and chemical analysis of 19 species of crops are provided. In addition to experimental data the opinions and experience of private farmers are quoted.

CANADA. **Report of the Minister of Agriculture for the year ended March 31, 1944.** Ottawa, 1944. pp. 186. **97**

The experimental Farms Service found that almost any crop can be ensiled satisfactorily provided it contains the proper amount of moisture and as little air as possible. Crops such as maize, sunflowers, artichoke, sorghums, millet and certain nutritive grasses with a high percentage of carbohydrate, are easily ensiled though hollow grasses may cause difficulty by their high proportion of air. Legumes and young grass with their high protein content are more difficult to ensile. Moisture content is the most important factor governing the process ; 65 to 70 per cent moisture is most satisfactory.

SOBERON, C. Un silo en cada explotación ganadera. Resolución del problema de escasez de forrajes en México. [**A silo on every stock farm. Solution of the fodder shortage problem in Mexico.**] *Tierra, Mexico* 1. 767-9 and 799. 1946. **98**

Advantages, disadvantages, and technique of ensiling.

CHOUSSY, F. El ensilaje en El Salvador. [**Ensilage in El Salvador.**] *Rev. agric., Guat.* 2. N.S. Nos. 15-20. 154-81. 1946. [Director General of Agriculture, Guatemala] **99**

Much information is presented on experiments, methods of ensilage, different types of silos, and suitable plants. The loss of nutrients being greater under ensilage than under haymaking, it is recommended whenever possible to convert plants into hay, and this leaves the following as the primary silage plants for El Salvador : (1) The grasses *Panicum maximum* and *P. purpurascens*, and to a smaller extent *Hyparrhenia rufa, Sorghum halepense, Pennisetum purpureum, Paspalum fasciculatum* etc., (2) *Sorghum vulgare*, (3) *Zea mays*.

GUATEMALA, Revista agricola. El ensilaje. [**Ensilage.**] *Rev. agric., Guat.* 2. N. S. Nos. 15-20. 151-213. 1946. **100**

At the request of Guatemalan agriculturists the Ministry of Agriculture of that country has devoted a section of its journal to

several articles on various aspects of ensilage. They comprise the following : F. Choussy, Ensilage in El Salvador ; C. Katz, Ensilage ; ensilage as feed for stock, methods of computing silage rations ; effect of silage on milk ; diminution of fire risks when silage is stored rather than hay ; cost of production of silage in the U.S.A. (for purposes of comparison) ; phosphoric acid and AIV. methods of ensilage ; ensilage with molasses ; the danger of gas in silos ; different types of silo ; notes on some experiments in the U.S.A. ; notes on some silage plants ; the advantages of ensilage.

MOULTON, G. A. Ensilaje. [**Ensilage.**] *Rev. agric. Guat.* 18. 47-52. 1941. **101**

KATZ, C. El ensilaje. [**Ensilage.**] *Rev. agric. Guat.* 2. N.S. Nos. 15-20. 185-9. 1946. [Ecuador] **102**

This article reprinted from *Sementera, Ecuador*, discusses the scientific basis of ensilage, different methods, advantages and disadvantages of the process.

PATERSON, D. D. **Grassland management in the West Indies.** *Imp. Bur. Past. For. Crops.* Bull. 31. pp. 7-29. 1944. **103**

TRINIDAD AND TOBAGO. **Administration Report of the Director of Agriculture for the year 1946.** pp. 28. 1948. **104**

Silage was made from *Pennisetum purpureum* in 1945 and was compared in the early part of 1946 with fresh grass as a feed for dairy stock. Although the grass fed fresh was both younger and of better quality than the grass used for filling the silo, a feeding trial showed that there was little difference between the two feeds. The losses involved in making the silage were small. The experiment is being repeated.

UNITED STATES, Sugar Research Foundation. Tech. Rep. Ser. No. 4. **Use of molasses in grass silage preparation.** By *C. B. Bender.* 1948. pp. 28. **105**

This review of 116 publications indicates that all green hay and pasture crops can be satisfactorily ensiled with molasses as a preservative. A pound of digestible nutrients in grass silage is equivalent to a pound of digestible nutrients in either maize silage or hay in terms of milk production. The ensiling process destroys substances causing taint or flavours in milk, and kills most noxious weed seeds.

The headings in this review article are : changes in composition of green crops during ensilage, the seepage problem, carotene preservation in silage, chemical composition, palatability, comparative milk production and growth values of molasses grass silage, and digestibility studies and physiological effects on the animal body.

WHYTE, R. O. **Grass silage in the United States of America.** *J. roy. Agric. Soc. Engl.* **109.** 140-7. 1948. **106**

NEW HAMPSHIRE Agricultural Experiment Station. Bull. 305. **Legume and grass silage. A survey of methods and results on 380 north-eastern farms.** 1938. pp. 23. **107**

The work is also published as New Jersey Agric. Exp. Sta. Bull. No. 643, 1938, and Vermont Agric. Exp. Sta. Bull. No. 434, 1938. Of the 380 operators replying to the questionnaire, 75 per cent said they would put up grass or legume silage for regular winter feeding, either to replace corn silage, hay or part of both. Sixty-eight per cent planned to use it to supplement pasture. Detailed instructions are given for the making of silage.

NEW JERSEY Agricultural Experiment Station. Bull. 684. **A survey of practices and costs of producing grass silage on 50 New Jersey farms.** By *J. W. Carncross, A. G. Waller* and *E. Rauchenstein.* 1940. pp. 16. **108**

VIRGINIA Agricultural Experiment Station. Bull. 227. **Silage experiments.** By *T. B. Hutcheson* and *T. K. Wolfe.* 1922. pp. 16. **109**

ERF, O. **The history of modern hay making**—Part II. *Jersey Bull.* 57. 459. 1938. **110**

ILLINOIS UNIVERSITY, College of Agriculture, Agricultural Experiment Station. Circ. 463. **Silage crops for dairy cattle.** By *W. B. Nevens.* 1936. pp. 16. **111**

MISSOURI Agricultural Experiment Station. Circ. 209. **Legumes, grasses and cereal crops for silage.** By *A. C. Ragsdale* and *H. A. Herman.* 1940. pp. 10. **112**

Technique with regard to time of cutting, method of harvesting, the relative merits of the molasses, A.I.V. and phosphoric acid methods, and the feeding of legume, grass or cereal silage.

CORNELL UNIVERSITY Agricultural Experiment Station. Extn. Bull. 160. **Silage crops in New York.** By *L. A. Dalton.* 1927. pp. 20. **113**

BOLETIM DE AGRICULTURA, MINAS-GERAIS. O problema das forragens na sêca. [**The problem of fodder during the dry period.**] *Bol. Agric. Minas-Gerais.* 7. 33-48. 1934. **114**

In Brazil the fodder shortage resulting from the period of drought which commences in April is often a source of loss to farmers. The problem may be solved by (a) haymaking, (b) ensilage. Methods, especially of ensilage, are discussed in detail.

MIRANDA, O. da R. Silos e silagens. [**Silos and silage.**] *Rev. Prod. anim., Rio de J.* 2. 223-34. 1935. [Fazenda Retiro Feliz, Brazil.] **115**

ALVES, L. Auxilio aos criadores para construcção de silos. [**Financial assistance for farmers in the building of silos.**] *Rev. Prod. anim., Rio de J.* 2. 235-7. 1935. [Director Geral, Dept. Nac. Produc. Animal, Rio de Janeiro.] **116**

In the first article the advantages of ensilage are stressed, and the question is discussed from the viewpoint of costs, in order to reduce which care should be taken (1) to suit the size of the silo to the number of stock to be fed ; (2) to build it as close to the farm buildings as possible ; and (3) to grow the silage crops as near the silo as possible.

The second article sets forth the terms under which the Government is prepared to render monetary aid to the farmers desirous of building silos. A grant of a certain sum per tonnage capacity is given, varying according to the type of silo, and payable when the building is two-thirds accomplished ; the silos to be built in accordance with conditions laid down by the Department of Animal Production and to be of not less than 20,000 kg. capacity in the case of raised types or 10 tons in the case of pit types.

COURETOT, D. La práctica de ensilaje en la provincia de Santiago del Estero. [**The practice of ensilage in the province of Santiago del Estero.**] *Granos* **10.** Nos. 10, 11 and 12. 36-9. 1946. [Dir. Agron. Reg., Min. Agric. Argentina] **117**

A radio address. Rainfall deficiency in June, July, August and September conditions a corresponding shortage of feeding stuffs in the Argentine province of Santiago del Estero during those months. Ensilage is urgently recommended by the Ministry of Agriculture. Methods of trench ensilage are outlined, the material recommended being *Zea mays, Euchlaena mexicana,* and different sorghums, namely, *Sorghum saccharatum* var. *minnesota, S. vulgare* var. *sudanense, S. vulgare* var. *typicum,* and *S. almum.*

VILLAMEDIANA, J. J. R. Importancia del ensilaje en Venezuela. [**Importance of ensilage in Venezuela.**] *Agricultor Venez.* 8. No. 91-92. 28-30. 1943. **118**

Shortage or absolute lack of herbage in summer renders the question one of vital importance for Venezuela's meat and milk supplies.

VILLEGAS, V., and ELEFAÑO, A. C. **A comparative study of the amount of soilage and silage consumed by Philippine and Nellore cattle.** *Philippine Agriculturist* 28. 543-52. 1939. [Dept. Anim. Husb., Laguna] **119**

Determinations, extending over periods of 16 to 24 days, were

made of the comparative amounts of Napier grass soilage and maize silage consumed individually by 7 Philippine and 6 Nellore cattle. The average daily consumption of soilage by Philippine and Nellore cows was statistically the same, whereas the Philippine bull consumed more feed than the Nellore bull. When silage was used as feed, the average amount consumed daily was significantly greater among Nellore cattle than among Philippine cattle of both sexes. The Philippine cattle consumed proportionately more soilage per 100 kg. liveweight than Nellore cattle of either sex, the females of both breeds consuming more than the males. When silage was used as feed, the amount consumed per 100 kg. liveweight by Philippine and Nellore cattle of either sex was about the same, the females of both breeds consuming more than the males.

The complete data are given in tabular form. [From N. A. and R.]

BURGESS, A. C. **The making of stack silage.** *N. Z. J. Agric.* 75. 437-46. 1947. [New Plymouth] **120**

All aspects of the subject are discussed including the place of ensilage in pasture management, value of silage as stock food, principles of ensilage, advantages of stack silage, cutting and carting the grass, stacking equipment, size and site of stack, stacking, covering and feeding to stock.

NEW ZEALAND FARMER. **Some points regarding ensilage. Modern ensilage a feature of grass farming efficiency.** *N. Z. Fmr.* 53. 678-9, and 697. 1932. **121**

NEW ZEALAND FARMER. **Some modern developments regarding ensilage. A review of the position by the Fields Division and Plant Research Station, N. Z. Department of Agriculture.** *N. Z. Fmr.* 53. 834-5. 1932. **122**

NEW ZEALAND JOURNAL OF AGRICULTURE. **Feeding ensilage to sheep. Farmers' experiences in past winter.** *N. Z. J. Agric.* 14. 237-43. 1930. **123**

SCOTT, M. J. **Adjustment of seasonal feed-supply to seasonal requirements of animals.** *Proc. 5th Conf. N. Z. Grassl. Assoc.* 1936. pp. 178-84. [Discussion, 184.] 1937. [Canterbury Agric. Coll., Lincoln.] **124**

Items discussed include supply of hay or silage reserves, and grass drying.

BARON-HAY, G. K. **Cheap silage conservation.** *J. Dep. Agric. W. Aust.* 9. (2nd ser.) 458-67. 1932. **125**

CULLITY, M., and CARISS, H. G. **Fodder conservation.** *J. Dep. Agric. W. Aust.* 20. 357-60. 1943. **126**

Fodder is conserved for the feeding of working horses over most of the year, or for other stock during the annual drought period in Western Australia, when pastures are deficient in quality and quantity. Such supplementary feeding avoids the necessity of disposing of stock at poor prices or of purchasing expensive fodders, and enables the stock-carrying capacity of the farm to remain at an even level throughout the year.

Fodder may be conserved either as hay, silage or grain, and in all cases the material must be properly stored to avoid loss from weather, fire or vermin. Hay is usually made from cereals, or grasses and clovers (meadow hay). Cereal hay should be cut at the stage of maximum value, stooked immediately and after curing is complete, stored in well constructed stacks. Meadow hay should contain a high proportion of clovers and its green colour should be preserved ; *Trifolium subterraneum* should not be cut before flowering. Excessive handling should be avoided and the hay stored in a shed or stack, or baled. Silage is also a palatable and nutritious fodder and the secret of making good silage lies in early cutting, quick carting, tight packing, and the exclusion of air. Good results may be obtained from well-protected pit or stack silos.

Additional concentrated food may be obtained from cereal grains, or lupins and peas. The grains should be carefully stored—preferably in bulk in converted sheds or tank silos. A table is given showing the necessary quantities of various fodders needed by different classes of stock.

CALLAGHAN, A. R. **Activities at Roseworthy Agricultural College, 1935-36. Pt. 1. An outline of wheat growing attainments and the conservation of fodder in the light of previous results from the College Farm.** *J. Dep. Agric. S. Aust.* 39. 1306-15. 1936. **127**

A tabulation of the conservation of fodder as hay and silage for the decade 1926-35.

CALLAGHAN, A. R. **Recent advances and experience in silage making.** *J. Dep. Agric. S. Aust.* 44. 690-7. 1941. [Roseworthy Agric. Coll.] **128**

CALLAGHAN, A. R., and BOWDEN, O. **Activities at Roseworthy Agricultural College, 1933-34. Pt. 4. The silage harvest—method and items of special interest.** *J. Dep. Agric. S. Aust.* 38. 170-85. 1934. [Principal (A.R.C.) and Farm Superintendent (O.B.).] **129**

A fully illustrated article on the silage method of conserving fodder, as it applies to local conditions.

JOHNSTON, W. C. **Some notes on fodder conservation.** *J. Dep. Agric. S. Aust.* 47. 411-5. 1944. [Exp. Sta., Kybybolite.] **130**

Green feed in South Australia can normally be expected from April to mid-November and means are noted by which deficiencies in the plane of nutrition for stock during the remaining months may be obviated. These include ensilage and the making of cereal and meadow hay. The following starch equivalent values have been calculated :

Type of Crop.	Yield per acre.	Starch Equivalent. Lb. per acre.
Oats as hay	2.5 tons	2044
Oats as silage	7.5 tons	1624
Oats as grain	34 bush.	857
Clover as hay	2 tons	1678
Clover as silage	6 tons	1756
Clover as grain	6.5 cwt.	612

SPAFFORD, W. J. **The manufacture and utilisation of silage.** *J. Dep. Agric. S. Aust.* 36. 133-79. 1932. **131**

Five papers giving comments and instructions on the practice of ensilage.

SPAFFORD, W. J. **Methods of conserving fodder.** *J. Dep. Agric. S. Aust.* 49. 539-41. 1946. **132**

The methods of fodder conservation best suited to South Australian conditions are described, including the manufacture and storage of cereal and pasture hay, the making of silage, and the storage of loose grain and straw.

MCKEON, C. J. **Fodder conservation in Queensland. 1. Silage and Silos.** *Qd agric. J.* 56. 295-308. 1941. **133**

MCKEON, C. J. **Fodder conservation.** *Qd agric. J.* 58. 197-210. 1944. **134**

The reduction in carrying capacity of pastures due to lowering of fertility and to overstocking has made it advisable to conserve fodder for periods of shortage. Information is supplied on the making and feeding of silage, crops suitable for silage (maize, sorghum, Sudan grass, millets, and mixtures with lucerne or cowpeas, and the winter growing crops, wheat, barley, oats and field pea), and silo construction.

THE AGRICULTURAL GAZETTE OF NEW SOUTH WALES. **The making of silage.** *Agric. Gaz. N. S. W.* 58. 126-30, 180-6. 289-94, 365-8 and 378. 1947. **135**

A comprehensive account of the desirable aims, advantages of use, and processes involved in the art of ensilage forms the first part

of this article contributed by the Division of Plant Industry. Where the effects of drought on a live-stock industry can be ruinous, as in Australia, it is especially important to provide adequate supplies of silage. Moreover, it is necessary to supplement pasture grazing at certain times of the year and this extra feed can most easily be obtained by conserving surplus pasture growth in the flush season either as hay or silage. As a feedstuff, the advantages of silage are its succulence and its preservation of food nutrients. The correct moisture content of material to be ensiled is 75 per cent and by careful stacking and tramping the temperature can be kept below 120°F. to prevent loss of nutrients and digestibility. There are many causes of spoilage in silage making and of deterioration in storage, and methods by which these can be prevented are described.

The situation and land utilization of a district in New South Wales largely determine the manufacturing conditions and type of crop used for silage. Thus, on the coast or under irrigation heavy yielding crops such as maize, millet and sorghum are used for filling pit, trench, tower and stack silos. Inland, however, barley, wheat and oats are employed predominantly in trench silos. Different types of silo are discussed and details are given of their costs, efficiency, construction and general utilization.

In the third portion of the article stack silage and the use of chemical agencies are the subjects. The making of stack silage is advisable where no delay and low cost are essential. Round stacks give excellent results with surplus pasture and the aim should be to build as tall as possible and cut respiration losses to a minimum. Framework of bush timber or saplings improves stack construction and reduces fodder losses. Materials such as lucerne which are high in protein content or very succulent crops such as rape are made easier to conserve by the addition of chemicals. Molasses is usually added to herbage and high-protein crops at the rate of 22 to 45 lb. per ton of fresh material. Alternatively a direct addition of acid may be made as in the AIV process which allows 5/8 lb. of commercial sulphuric acid or 2 lb. of commercial hydrochloric acid to the gallon of water and is specially important for preserving the vitamin A and carotene content of the product, but is seldom used in Australia. Amount of acid recommended for addition to each 200 lb. of green forage are as follows: clover and other legumes, 1.25 gallons; young grass, 1 gallon; clover-grass mixtures, 9 pints; gale and root crops, 6.5 pints.

The concluding section deals with crops suitable for silage and with feeding silage to sheep and cattle. *Zea mays*, *Sorghum* spp., and *Panicum frumentaceum* all make good silage and correct times are given for cutting, which in most districts is postponed too late. Winter cereals should be cut at early flowering time and pastures when the principal plant species is in flower; white clover, lucerne,

vetches and peas are also best when cut in full bloom. Questions of storage, safe reserves and animal feeding in relation to silage making are discussed and suitable rations are suggested for sheep and dairy cattle.

AGRICULTURAL GAZETTE OF NEW SOUTH WALES. **Make silage of surplus pasture.** *Agric. Gaz. N. S. W.* 46. 88-9. 1935. **136**

SMITH, J. W. G. **Conserved pasture hay and silage. A means of increasing dairy production.** *Agric. Gaz. N. S. W.* 60. 7 and 10. 1944. **137**

The vigorous growth of pastures in the Riverina in 1943 is illustrated by photographs. On one 5-acre pasture consisting of *Lolium* sp. *Trifolium subterraneum* and trefoil, grazed bare in May and July, 60 tons of fodder were cut in October and ensiled in pits. Pasture silage and meadow hay for correct supplementary winter feeding are to be encouraged if uniform milk production all the year round is desired.

WHITTET, J. N. **Grass silage. An excellent method of storing excess pasture growth.** *Agric. Gaz. N. S. W.* 41. 865-70. 1930. **138**

WHITTET, J. N. **Composition and fodder value of grass silage.** *Agric. Gaz. N. S. W.* 43. 167-73. 1932. **139**

Popular notes on methods and analysis of silage.

D. CROPS AND GENERAL AGRONOMY

THE AGRICULTURAL GAZETTE OF NEW SOUTH WALES. **Pea vinery by-products have high food value as green fodder, silage, and hay.** *Agric. Gaz. N. S. W.* 55. 451. 1944. **140**

These are valuable protein-rich foodstuffs that may be fed to all classes of live-stock as green fodder, hay or silage. The protein content of the dry matter averages about 12 per cent.

AIKKINEN, I. Särskild växtföljd för AIV-fodermaterial. [**Separate rotation of crops for AIV fodder material.**] *Lantm. Svenskt Land.* 25. 711-3. 1941. **141**

The relation between the type of ley, cutting times, and obtaining satisfactory material for AIV fodder is discussed. For the best results an independent rotation is recommended.

BAEROE, O. L. AIV-foret. Legg gras i silo midt i juni. Det gir tidligere slåttonn, bedre høi og mere hå. [**AIV fodder. Grass should be ensiled in the middle of June. This results in an earlier mowing season, better hay and more aftermath.**] *Tidsskr. norske Landbr.* 48. 121-3. 1941. **142**

The high value of young grass for AIV silage is emphasized. As the fodder value remains at its zenith for but a few days, mowing should preferably be completed in 2 or 3 days, or at most in a week. Ensiling is particularly suitable for short grass which cannot be dried on hurdles. At the Agricultural College of Norway about one-third of the meadow area, more than 100 dekar, was cut for silage in 1940. A considerable extension of this method of conservation is recommended.

BARTLETT, J. W. **What is the truth about grass silage?** *Cert. Milk Conf.* 13. 149. 1938. **143**

BARTLETT, J. W. **Silo problems created by grass crops.** *Agric. Engng St. Joseph, Mich.* 20. 181-2 and 186. 1939. [New Jersey Agric. Expt. Sta.] **144**

Five chief problems arise: (1) the relation of moisture in grass to its successful preservation as a silage; (2) economical methods of harvesting and silo filling; (3) the correct preservative and its application: (4) the roughages to put in the silo; (5) the quantity of grass to be preserved in the form of silage and hay. The author presents the experience of the New Jersey Agric. Expt. Sta. on these questions.

BECHTEL, H. E., ATKESON, F. W., and HUGHES, J. S. **Brown silage from Atlas sorgo—chemical composition, and apparent digestibility as determined by feeding to dairy cows.** *J. Anim. Sci.* 2. 295-303. 1943. [Kansas Agric. Exp. Sta.] **145**

Brown silage from *Sorghum vulgare* was lower than normal green silage in digestion coefficients, particularly in protein, but also in dry matter, ether extract, crude fibre and N-free extract. The reduction of digestibility varied with the temperature to which the silo was heated. Based on their chemical analyses these brown silages would be classed as good feed since they contained measurable quantities of carotene, an unstable substance. Brown silage was less palatable than normal silage.

BECKER, R. B., ARNOLD, P. T. D., DAVIS, G. K., and FOUTS, E. L. **Citrus molasses—a new feed.** *J. Dairy Sci.* 26. 735. 1943. **146**

Samples of citrus molasses, a by-product of the citrus canning industry, contained 4 per cent crude protein, 0.94 per cent calcium nitrate, no fibre and little fat, reducing and non-reducing sugars constituting about two-thirds of the dry matter. The molasses was highly palatable to dairy cows when mixed with concentrates at levels of 5 and 10 per cent but not when fed separately. A slight but not objectionable flavour was imparted to milk when the concentrate containing 10 per cent molasses was fed 2 hours before milking. Addition of citrus molasses at levels of 2 and 4 per cent to Napier grass during ensiling improved the aroma and palatability of the silage. Pigeon pea ensiled satisfactorily with an addition of 4 per cent of citrus molasses. [N. A. and R.]

BECKER, R. B., ARNOLD, P. T. D., DAVIS, G. K., and FOUTS, E. L. **Citrus molasses—a new feed.** *J. Dairy Sci.* 27. 269-73. 1944. [Florida Agric. Exp. Sta., Gainesville] **147**

Citrus molasses, a by-product of the canning of *Citrus medica*, was produced in Florida on a commercial scale during the season 1941-42 with a production of 2500 tons. This was increased to 4700 tons during the 1942-43 season. Citrus molasses has acted as substitute for blackstrap molasses which has not been available for feeding purposes due to its being required for manufacture of war materials.

The composition of citrus molasses is not wholly standardized. It consists mainly of reducing and non-reducing sugars ; there are no fibres and but little fat. The samples tested contained 4 per cent crude protein and over 0.9 per cent calcium nitrate. The total digestible nutrients and digestible crude protein were estimated to be 56.7 per cent and 1.4 per cent respectively. Citrus molasses proved to be highly palatable when mixed with concentrates at 5 and 10 per cent levels, but much less so when offered separately.

When fed 2 hours before milking there was a slight but not objectionable flavour in the milk. Pigeon pea (*Cajanus indicus*) and a non-saccharin grass (*Pennisetum purpureum*) ensiled satisfactorily with citrus molasses.

BENDER, C. B. **Molasses hay silage.** *N. J. Agric.* 17. 3-4. 1935. **148**

BOHSTEDT, G. **The preparation and nutritive value of grass silage.** *Proc. Amer. Soc. Anim. Prod.* 33rd Ann. Meeting, 55-63. 1940. [Univ. Wisconsin] **149**

A discussion of methods of preparation, utilization and effect upon milk production.

BOLTZE, Sonnenblume als Gärfutterpflanze. [**The sunflower as a silage plant.**] *Grünland u. Landeskult.* 8. No. 11. 1. 1931. **150**

Successful experiences of growing sunflowers for silage and for green manuring before a potato crop are described, and the plant is recommended for these purposes and as a particularly useful crop in rotation with *Vicia villosa* to prepare light and sandy soils for the growing of lucerne. Directions for growing and harvesting the crop and for ensilage are given. A particularly important requisite for successful growth is adequate liming, as the sunflower is highly susceptible to soil acidity. The Plant Breeding Institute at Landsberg (Warthe) is studying élite plants supplied by the author with a view to producing a high-yielding strain suitable for local conditions and the poorest of soils.

BOMBAY, ANAND, Institute of Agriculture. Fourth Annual Report of the Governing Body of the Institute of Agriculture, Animal Husbandry and Dairying. 1944. Anand. pp. 40. **151**

Different methods of ensiling at Chharodi farm tested the effects of molasses and heavy and light packing. *Andropogon annulatus* responded well to added molasses making a silage rich in protein, but heavy packing did not give any superior results.

BOND, J. R. **Practical ensilage.** *Farming* 2. 35-9. 1948. **152**

Both old and new grassland produces material well adapted for ensilage, and new and fairly new grassland being responsive to nitrogenous top dressings can be induced to yield a surplus of growth for ensilage without encroaching on the pasture or hay requirements of the mainly grass farm. Autumn-sown rye, ready in April or May; autumn-sown legume/cereal mixtures, ready when in flower in June ; spring-sown mixtures, ready in June or early July ; and early-sown kales, ready in September are crops also suitable for ensiling. The various techniques for dealing with these crops, temperature control and wastage and designs for trench silos all based on practical experience are given

BONDI, A. **The ensilage of citrus fruit pulp.** *Emp. J. exp. Agric.* 10. 89-92. 1942. [Agric. Res. Sta., Rehovot, Palestine] **153**

Experiments in ensiling grapefruit and orange pulp in barrels showed that after 8 months the pulp was well preserved. On a dry matter basis there was a fall in the percentage of N-free extract and sugars and an increase in the percentages of protein, fat, crude fibre and ash. The silage contained acetic acid, appreciable quantities of lactic acid but little or no butyric acid and was readily consumed by cattle and sheep. No improvement in the product was obtained by addition of mineral acids but minced pulp was better than unminced. A large scale experiment with 10 tons of minced orange pulp in a cement silo gave a product similar to that of the small scale experiment except that there was a greater loss of sugar with production of larger amounts of lactic and acetic acids. The material was free from butyric acid. [N. A. and R.]

BORRIES, v. Sonnenblumensilage. [**Sunflower silage.**] *Mitt. dtsch LandwGes.* 48. 34. 1933. **154**

A correspondent reports the successful growing of sunflowers (Hungarian white-seeded variety) on land unsuitable for other crops, and their conversion together with an equal quantity of maize into silage, which furnished a satisfactory fodder for cows, horses and pigs.

BOSMAN, F. H. **Lucerne silage.** *Fmg S. Afr.* 11. 146. 1936. [Grootfontein Sch. of Agric., Middelburg, C.P.] **155**

When conditions in the Karroo are unfavourable for haymaking, a portion of the *Medicago* crop is utilized for silage production. About 40 lb. of molasses is required for each ton of material. Where a maize crop is available a mixture of three or more parts of maize to one of lucerne is recommended.

BREIREM, K. AIV-fôr av fôrbeteblad. [**AIV fodder of fodder beet leaves.**] *Tidsskr. Norske Landbr.* 49. 144-52. 1943. **156**

AIV fodder from beet tops is a valuable feeding stuff. Compared with fresh tops it has the advantage that it is richer in dry matter, is more palatable and contains less oxalic acid. Calculated on organic matter the nutritive value is as high as for acid fodder of grass both as regards the fodder unit and protein. The calcium and carotene contents are high. For dairy cows 20 to 25 kg. AIV fodder of beet tops can be fed per day. This fodder covers an essential part of the protein requirement and gives milk with a large content of vitamin A. Acid fodder should be fed after milking. To produce good acid fodder from root tops harvesting should be carried out so that the tops are as clean as possible.

BREIREM, K., and FYRILEIV, E. Surfôr av rene og skitne rotvekstblad. [**Acid fodder from clean and dirty root tops.**] *Tidsskr. norske Landbr.* 53. 37-49. 1946. **157**

Clean root tops contain approximately 15 per cent ash in the dry matter. The admixture of some soil is unavoidable during harvesting of the tops so that the ash in the dry matter in acid fodder of clean tops commonly amounts to 20 to 25 per cent. With such an ash content good digestibility and high feed value is ensured. If the ash content in the dry matter amounts to 25 to 30 per cent or more, the acid fodder is to be characterized as dirty.

With a large admixture of soil, digestibility of the organic matter is reduced. The fodder unit value and the content of digestible protein decline. The amount of clean acid fodder equivalent to one fodder unit can be computed at 7 to 8 kg., while that of seriously contaminated acid fodder is 10 to 15 kg. Animals eat dirty acid fodder with reluctance; it has an unfavourable dietetic effect, and yield declines compared with feeding with clean acid fodder. The deleterious properties of dirty acid fodder are less potent if the fodder is used in moderate quantities together with other feeding stuffs. So that the root tops may be as clean as possible, they should be carted off the field before the roots are removed.

BROWN, G. F. **Grass silage and soil conservation.** *Soil Conserv.* 7. 19-22. 1941. [Soil Conserv. Ser., Upper Darby, Pa.] **158**

A discussion of four methods of converting the grasses and legumes grown for conservation purposes into silage, with notes on costs, nutritive value and the construction of the necessary farm buildings.

BUENGER, Vergleichende Anbau- und Fütterungsversuche mit Sonnenblumen. (**Comparative growth and feeding trials with sunflowers.**) *Grünland u. Landeskult.* 8. No. 12. 1-2. 1931. **159**

A comparison of the productive and nutritive value of sunflowers and maize made in 1928 and 1929 at the Friedrichsort Experimental Farm, Kiel, proved that sunflowers are a suitable crop to grow for silage under climatic conditions which render the growing of maize uncertain. The sunflowers gave a higher yield in both green and dry weight, not only in the somewhat severe climate of Kiel, but also in the unusually hot, dry summer of 1929. Sunflowers appear to be more palatable when harvested at an early stage; it is therefore advisable to harvest not later than when they are in full bloom, and for the success of the silage the addition of molasses or fodder sugar is recommended.

BUENGER, and GLET. Der Anbauwert von Topinambur als Silopflanze. [**The value of Helianthus tuberosus as a silage plant.**] *Mitt. dtsch. LandwGes.* 47. 557-9. 1932. [Preuss. Versuchs- u. Forschungsanst. f. Milchwirtschaft, Kiel] **160**

Only recently has any breeding of *Helianthus tuberosus* taken place in Germany, but the Kaiser Wilhelm-Institut at Müncheberg has now produced a satisfactory type, with which trials have been conducted by the Prussian Dairy Research Institute, Kiel, on the Friedrichsort Experimental Farm. Growth was vigorous and good yield of green weight was obtained. The crop was ensiled by the low temperature process, the silage having a high lactic acid and low acetic and butyric acid content. A one per cent addition of sugar probably contributed to the success of the ensilage. Feeding trials were conducted with dairy cows; their health remained normal, only slight variations in live weight were noted, milk production and the fat content of the milk was uniform, and the silage was taken with relish. It is concluded that for local conditions (light soil, rough and cold weather with periodical drought) *Helianthus tuberosus* constitutes a satisfactory silage plant. It should be cut early in September. A suitable crop rotation is suggested.

BURKHARDT, E. Einsäuerung von eiweissreichem Grünfutter unter Zusatz von eingesäuerten Kartoffeln. [**Ensilage of green fodder rich in protein with the addition of ensiled potatoes.**] *Landw. Jb.* 90. 793-820. 1940. [Landw.-Chem. Inst., Univ. Jena] **161**

The material comprised the Landsberg mixture (*Trifolium incarnatum, Vicia villosa* and *Lolium italicum*), *Medicago*, and grass.

CANADA, Department of Agriculture. Publ. 735. Fmrs. Bull. 110. **Alfalfa for hay, silage and pasture.** By *J. M. Armstrong, F. S. Nowosad* and *P. O. Ripley*. 1942. pp. 31.

———— Special pamph. No. 61. **Alfalfa for hay, silage and pasture.**. By *J. M. Armstrong, F. S. Nowosad* and *P. O. Ripley*. 1942. pp. 4. **162**

CANADA, Department of Agriculture, Division of Forage Plants, Experimental Farms Service. Publ. 805. Circ. 177. **Reed canary grass.** By *W. J. White, R. M. MacVicar* and *F. S. Nowosad*. 1948. pp. 7. **163**

Brief notes on description, adaptation and culture are given. Its utilization for pasture, hay, silage and as a soiling crop, as well as seed production are discussed.

CARR, W. A. C. **Arable crops for silage.** *J. Minist. Agric.* 50. 511-4. 1944. [Cheshire War Agric. Exec. Comm.] **164**

There is discussion of the range of crops suitable for silage, mixtures which will give two or three cuts, the advantages of marrow-stem kale, a 1-year seeds mixture, and weeds in silage crops.

CHARLEY, V. L. S., LING, A. W., and SMITH, E. L. **Apple pomace silage. Report on experiments conducted in 1941.** *Ann. Rep. agric. hort. Res. Sta.*, Bristol. 1942. 101-6. **165**

Unextracted apple pomace can be conserved in the form of silage by the addition of agricultural salt. (A high salt content is objectionable). The pomace can be ensiled as a mixture with grass cuttings, 1 part by weight of grass to 6 parts of the pomace. Chopped straw and extracted apple pomace are not readily ensiled owing to the great disparity in bulk of the components.

CHARPENTIER, C. A. G. Erfarenheter rörande beredningen av AIV-fodder av åfräken (Equisetum fluviatile L.) [**Experiences regarding the preparation of AIV fodder from Equisetum fluviatile L.**] *Tidskr. Lantmän.* 16. 179-80. 1934. [Pasture Expt. Sta., Mouhijärvi, Selkee, Finland] **166**

Good AIV fodder can be prepared from this plant; although it is not as valuable as that prepared from green fodder or clover aftermath, the high price of concentrates justifies its use.

COOK, L. J. **Subterranean clover and grass ensilage.** *J. Dep. Agric. S. Aust.* 36. 1065-9. 1933. [Exp. Farm, Kybybolite] **167**

Practical advice as to technique and discussion of value of silage.

COOP, I. E. and SEARS, P. D. **Effect of time of shutting and stage of growth for hay and silage on pasture production.** *N. Z. J. Sci. Tech.* 24. 303A-16A. 1943. [Dept. Sci. Ind. Res., Palmerston, North] **168**

Data from a single season show that to obtain high quality silage it is necessary to close paddocks early and to cut when still leafy. For higher total yields of dry matter it is better to cut the crop after being closed longer although in this case the total yield of digestible nutrients is more likely to be lower. The greatest factor influencing total production is the weather immediately following cutting. Thus, it is better to shut paddocks as early as possible, because the liability to unfavourable recovery becomes greater as the season advances.

CORNELL University Agricultural Experiment Station. Bull. 548. **Corn and soybeans for silage.** By *R. G. Wiggans.* 1932. pp. 36. **169**

Results of agronomic trials of *Zea mays* and *Glycine soja*, grown alone and in mixtures, and a discussion of their relative value and methods of cultivation.

CORNELL Agricultural Experiment Station. Bull. 634. **Combinations of corn and soybeans for silage.** By *R. G. Wiggans.* 1935. pp. 34. **170**

The Bulletin reviews the experimental work which has been undertaken on this combination of crops, dealing with a number of cultural questions and the suitability of different varieties. Feeding value, productivity and digestible nutrients are also discussed.

DAWSON, R. B. **Silage from lawn mowings.** *J. Bd. Greenkeep. Res.* 6. 157-61. 1941. **171**

DIJKSTRA, N. D. Onderzoek naar de bewaringsmogelijkheden van het natte product, dat bij de ontsluiting van stroo wordt verkregen [**Experiments in the ensilage of wet straw treated with caustic lime.**] *Versl. landbouwk. Onderzoek.* No. 50 (7) C. 231-46. [German and English summaries, 244-6.] 1945. [Agric. Exp. Sta. Hoorn, Netherlands] **172**

Wet pulp of wheaten straw (at 55 to 75°C.) received from a strawboard factory was well preserved, only a few spots on the surface having become mouldy. One part had been ground in the factory and was put into one silo, the unground material into another silo and some into a trench silo. Silos and trench were opened after 4 to 7 months and the contents were fed to dairy cows. The material of both silos was well preserved ; there was no mould ; the chemical composition of the hydrolysed straw had hardly changed except that there was a greatly increased percentage of butyric acid ; losses in the ground material equalled those in the unground, so that grinding was proved unnecessary. Although there was no mould in the trench silage and there was little change in most of the product, the top layer was slightly decomposed, especially at the sides, and it was rather difficult to separate the silage from the earth. Coefficients of digestibility for the organic matter, crude fibre and N-free extracts of the trench silage were 49.5, 65.7 and 38.2 respectively, whence a starch value of 29.8 on dry matter basis was calculated.

DIJKSTRA, N. D. Voederproef met geënsileerd aardappelloof. [**A feeding trial with potato-tops silage.**] *Versl. Landbouwk. Onderzoek.* No. 51 (7) 91-130. 1945. **173**

Silage prepared by the addition of AIV solution was submitted to digestibility trials with sheep. The starch equivalent is comparable to that of good grass silage, but the protein value is much higher. Dairy cows ate the silage well when they became accustomed to it.

DMITRIEVSKAJA, L. N. [**Economic evaluation of fodder cabbage cultivation for green forage and silage.**] *Trudy Sever. N.-I. Inst. Mol. Hozjaistva.* No. 6. 26-31. 1933. [Northern Res. Inst. Dairying, Archangel] **174**

This is a comparative economic study of various methods of cultivation of fodder cabbage based on the cost of production of 1 kg. digestible true protein per ha. Cultivation is found to be profitable only when leaf yield is over 40 m. per ha. Mechanization may possibly reduce cost.

DREW, J. P. **Meadow silage.** *J. Dep. Lands Agric., Dubl.* 26. 130-2. 1926. **175**

DREW, J. P., O'SULLIVAN, G. F., and DEASY, D. **Grass silage.** *J. Dep. Agric. Irish Free St.* 29. 1-22. 1929. **176**

EDIN, H., BERGLUND, N., and ANDERSSON, Y. Undersökningar angående gränfoder samt metoderna för dess konservering. III. Fodermärgkål. Av fodermärgkål och kålrotsblast framställt ensilage. [**Investigations concerning green fodder and methods for its conservation. III. Marrow stem kale. The silage prepared from marrow stem kale and the leaves and tops of swedes.**] *K. LandtbrAkad. Handl. Stockh.* 72. 502-40. [English summary 537-40.] 1933. **177**

EDIN, H., KIHLÉN, G., ERICSSON, G., and WINKLER, H. Slåttertidsförsök å vall utförda vid Offers försöksgård åren 1930-34. Skördetidens inflytande på vallbeståndets botaniska karaktär, på sammansättningen, smältbarheten, fodervärdet och användningsvärdet ("Kraft-fe") av därav framställt hö och AIV-foder samt på hektarskördens storlek och användningsvärde. [**Harvesting studies on Offer Experimental Farm during the years 1930-34. Effect of time of harvesting on the botanical composition of pasture, on the composition, digestibility and feeding value of hay and AIV silage and on the yield and economic value.**] *Rep. No.* 461, *Central Agric. Res. Inst., Stockholm*, 1936, pp. 54. English summary. **178**

Data are given for the composition of 12 types of hay and of AIV silage of clover aftermath (60 per cent) at the early budding stage and timothy with only sterile shoots. 100 kg. hay cut early gave 2.6 kg. and medium early cut 0.6 kg. more digestible true protein and 21 and 9 feed units more than late cut hay. Further the ratio of feed units to dry substance fell with increase in age at cutting.

A method is devised of translating these differences into money value. Where the cost of straw is low, the value of early cut hay is 13 per cent greater than that of medium early and 33 per cent greater than that of late cut hay. In practice the combination of medium early maincrop cutting with early aftermath gives the best general results. [From N. A. and R.]

EGOROVA, T. D. [**On the time of harvesting potato tops for silage in relation to the yield and size of tubers.**] *Trudy Belorussk. Seljskohoz. Inst.* 8 (30). 135-7. 1939. **179**

Early cutting (50 days before tuber harvest) increased the yield of forage, but the yield and size of tubers were much reduced, as compared with later cuttings. Cuttings of tops 3 to 4 days before tuber harvest is preferable ; the yield of forage was reduced from 14-15 to 6-7 tonnes per ha., but the yield of tubers and their size remained unchanged.

EGOROVA, T. D. [**The time of harvesting tops of fodder beets and turnips for silage in relation to the yield and size of roots.**] *Trudy Belorussk. Seljskohoz. Inst.* 8 (30). 138-40. 1939. **180**

The size of the second crop was larger the earlier the first cut. Early cutting of tops (50-60 days before root harvest) caused a much reduced yield of roots ; cutting of tops should not be earlier than 3-4 days before root harvesting in the case of turnips and 4-6 days before in the case of beets.

ELLIS, J. H. **Silage crops other than corn.** *Agric. Gaz. Canada* 6. 540-1. 1919. **181**

ELMSTRÖM, B. Ensilering av drav enligt AIV-metoden. [**Ensiling of draff according to the AIV method.**] *Lantm. Svenskt Land.* 24. 575-6. 1940. **182**

Concentrated feeding stuffs cannot be imported into Sweden. The summer is dry and there is a risk of a considerably reduced yield of fodder crops. If draff (brewers' grains)be used in the ration, a saving of hay, concentrated fodder and succulent fodder is effected. In draff the dry matter content is 23 to 24 per cent and the digestible protein as high as 3.5 per cent. Approximately 5 kg. = one food unit. The hectolitre weight lies between 70 to 90 kg. depending upon the method of preparation. AIV-treated draff can be used for feeding about a fortnight after putting down. Draff is deficient in minerals so these must be added to the ration. When it is fed in the winter it should be taken in some time before it is given to the animals as under no circumstances should it be fed at a temperature below 0°C. Carefully ensiled draff keeps for at least a year.

ENGLAND AND WALES, Ministry of Agriculture and Fisheries. "Growmore" leaflet No. 40. **Ensiling sugar-beet tops.** [**n.d.**] pp. 4. **183**

Fresh sugar beet tops are equivalent in feeding value to the same weight of swedes. The silage can be fed to almost any class of

stock, suitable amounts being 56 lb. per day to a fattening bullock, 28-42 lb. to a dairy cow, and up to 3 lb. daily per 100 lb. live weight for sheep. To avoid tainting milk, cows should be given the silage immediately after milking, preferably on grass in the open air.

ERIKSSON, S. Ensileringsförsök med klöver och rotfruktsblast. [**Silage from clover and root-tops.**] *K. LantbrAkad. Tidskr.* 86. 228-44. [English summary, 243.] 1947. **184**

The influence of the stage of development of green fodder at cutting upon the loss of nutrients and upon the quality of the silage has been studied in two experiments with clover from six different cuts. The influence of the increased content of dry matter in later cuts was eliminated by drying the fresh crops to about 30 per cent of the dry matter. The trials showed that the amount of dry matter in the silo decreased in later cuts. The loss of dry matter during the drying decreased.

In two experiments root-tops were ensiled without and with an addition of AIV-solution and potato silage. The two additions yielded about the same loss of nutrients and a good silage, whereas the experiments without an addition resulted in a great loss and a silage of poor quality. Chopped root-tops resulted in a 5.6 per cent lower loss of dry matter and a better quality of silage than whole root-tops. The amounts of tops in the silo volume increased by chopping.

FAGAN, T. W., PHILLIPS, R., and DAVIES, R. O. **Kales and kale silage.** *Welsh J. Agric.* 18. 75-8. 1945. [Univ. Coll., Aberystwyth] **185**

Chemical examination of four types of kale between 12.10.42 and 14.1.43 showed that Thousand Headed, Hungry Gap, and Rape kale contain slightly more dry matter than marrow-stem kale, and that the dry matter of Hungry Gap and Rape kale is considerably higher in protein and lower in fibre than the other kales. In total yield of crude protein marrow-stem (thinned) and Thousand Headed kale were respectively equal and greater than Hungry Gap, marrow-stem (unthinned) and Rape kale. Protein content of Hungry Gap and Rape kale increased as the season advanced in contrast to protein in other kales. The chemical composition of samples of marrow-stem kale silage is given together with the loss of nutrients during ensilage.

FENTON, E. W. **Bracken possibilities. Potash, silage and manure.** *Fmg News N. Brit. Agric.* April 25. 1941. p. 1. [Edinb. and E. Scot. Coll. Agric.] **186**

FERGUSON, W. S. **Marrow-stem kale silage.** *J. agric. Sci.* 37. 77-80. 1947. [Jealott's Hill Res. Sta., Bracknell, Berks.] **187**

Kale silage was made in five large silos and the losses of dry matter and kale constituents determined. The losses of dry matter averaged 33 per cent, of N-free extract 41 per cent and of crude protein 34 per cent. The percentage losses are higher than with well-made grass silage, but, nevertheless, the yields of silage (and animal nutrients) per acre compare very favourably with those of other crops, including grass. Inclusion of straw in kale silage did not reduce losses of dry matter; it merely reduced slightly the quantity of water lost.

FERGUSON, W. S., and NEAVE, O. **Bracken ensilage.** *J. agric. Sci.* 34. 172-5. 1944. [I.C.I., Ltd., Jealott's Hill Res. Sta., Bracknell, Berks.] **188**

Studies of the chemical composition, digestibility and palatability of *Pteridium aquilinum* show that ensiling the plant is unlikely to prove profitable.

FROLICH, G., and LÖWE, H. [**Ensilage trials with sugar-beet leaves treated with HCl.**] *Futterkonservierung* 4. 107-115. 1933. **189**

GALLUP, W. D., and KUHLMAN, A. H. **The composition and digestibility of mung-bean silage, with observations on the silica-ratio procedure for studying digestibility.** *J. agric. Res.* 52. 889-94. 1936. **190**

The apparent digestibility of mung-bean (*Phaseolus* sp.) silage is reported for the first time. Digestion experiments were carried out with four milk cows receiving a ration composed solely of this silage.

GEITH, R. Anbau und Futterwert der Futtermalve. [**Cultivation and nutritive value of the fodder mallow.**] *Mitt. Landw.* 51. 313. 1936. [Betriebsw. Forschungsstelle f. Grünlandwirtschaft, Univ. Leipzig] **191**

Kahsnitz's account of the testing of Lampe's fodder mallow in Pomerania is supplemented by a report of results obtained in similar trials at the Experimental Station, Rostock, and at the Plant Breeding Institute, Giessen. Experiments in haymaking resulted in an average loss of 50 per cent of the nutrients, especially protein, even when the greatest care was exercised. The growing of mallows for hay is therefore not recommended. Trials of ensilage resulted in the production of a useful, though not uniformly palatable fodder. It is considered, however, that there is room for further experimentation here. The crop is not yet beyond the experimental stage, but trials on a small scale by farmers have confirmed the findings of the Experiment Stations.

GLUBOKOV, T. P. [**Perennial sunflowers as a fodder for agricultural animals.**] *Soc. zern. Hoz.* 1938. No. 2. 84-9. [Regional Sch. Agric., Saratov] **192**

The percentage of leaves in cuts varied from 62.1 (*H. maximiliani*) to 11.0 (*H. giganteus*) when measured at the end of June, and from 56.8 (*H. maximiliani*) to 65.4 (*H. grosse-serratus*) a month later. The aftermath was formed very vigorously, particularly by *H. giganteus*. *H. maximiliani* was superior in forage yield, but inferior in nutrient content to the others, particularly to *H. grosse-serratus* and *H. orgylis*, which were richest in proteins (17.06 and 17.31 per cent) ; the highest hygroscopical moisture (8.29 per cent) was contained in plants of *H. annuus* × *H. divaricatus*. All *Helianthus* species tested (which included also *H. argyrophyllus* and *H. occidentalis*) were resistant to drought and grew rapidly after mowing, giving two cuts in a dry summer. The first cut (in June) is recommended for forage and the second (in September) for ensilage.

GNEIST, K. Silierversuche mit Gras von berieselten Wiesen. [**Silage experiments with grass from irrigated meadows.**] *Landw. VersSta.* 121. 157-74. 1934. **193**

HAMLIN, F. H. **Grass silage.** *Agric. Engng. St. Joseph, Mich.* 19. 471-2 and 478. 1938. **194**

In 1936 " grass silage " was little used on farms in the United States, but in the following year several thousand farmers made and fed it successfully. It is suggested that over half a million farmers will adopt grass silage in the course of the next few years. Upwards of 40 million tons of silage made chiefly from corn and the sorghums are fed in U.S.A. annually ; the loss of original nutrients may be less than 10 per cent. About 80 million tons of hay are fed, and nutrient loss is anything up to 30 or 40 per cent. This radically new practice offers a cheap solution to two pressing problems, namely, the difficulty of curing early hay crops, and the drying up of pastures in mid-summer. The resulting feed is more productive than hay, faster, easier and cheaper to harvest, store and feed. A higher protein silage than corn is produced at about 30 per cent less cost per ton ; less grain and concentrates are required. It is a rich source of carotene and " grass juice factor," a new growth-promoting vitamin recently isolated at the Wisconsin Station (Wisc. Sta. Bull. 439).

HAYDEN, C. C., PERKINS, A. E., KRAUSS, W. E., MONROE, C. F., and WASHBURN, R. G. **Legume silage for dairy cows.** *Bi-m. Bull. Ohio. agric. Exp. Sta.* 22. 21. 1937. **195**

HELLBERG, A. Försök med ensilering av fodermärgkål. [**Ensiling investigations with marrow stem kale.**] *K. LantbrAkad. Tidskr.* 79. 261-9. [English summary, 269.] 1940. **196**

HELLBERG, A. Försök med ensilering av potatisblast. [**Ensiling potato tops.**] *K. LantbrAkad. Tidskr.* 80. 1-11. 1941. **197**

Potato top silage is less palatable than grass silage but cows will eat it without difficulty if it is of good quality and they have become accustomed to it. Large quantities fed to cows caused a bitter taste in their milk. [D. S. A.]

HELLBERG, A. Försök med ensilering av potatisblast. [**Ensiling potato tops.**] *K. LantbrAkad. Tidskr.* 80. 80-8. [English summary, p. 87.] 1941. **198**

If potato tops are harvested at or shortly after flowering they contain 20-23 per cent crude protein, 18-21 per cent crude fibre in dry matter with 15 per cent ash. It is necessary to add acid to obtain silage of good quality. The material has satisfactory digestibility, but is not as palatable as silage from grassland products. It should be fed to milking cows only in small quantities to avoid milk taint.

HELLBERG, A. Versuche mit Ensilierung von Markstammkohl. [**Experiments in the ensilage of marrow stem kale.**] *Biederm. Zbl. B. Tierernähr.* 14. 101-11. 1942. [Landw. Hochsch., Uppsala, Sweden] **199**

Experiments in the ensilage of marrow stem kale (*Brassica oleracea*) were concerned principally with optimal fineness of chopping, lengths ranging from 10 to 1 cm. being studied. It was found that a first-class silage with little loss can be obtained best and least expensively through a relatively fine chopping of the kale: the addition of acid is unnecessary when the kale is finely chopped. If the drainage can be collected and fed also, the value of this method is increased.

HEWITT, A. C. T. **Pea-vine silage.** *J. Dep. Agric. Vict.* 44. 57-8. 1946. **200**

Haulms and empty pods of canning peas can be converted into a silage equal in food value to mixed pasture silage. The product should be fed to dairy cows in the paddock, immediately after milking.

HINTON, S. A., and WYLIE, C. A. **Comparison of Lespedeza sericea silage, alfalfa silage, and corn silage for dairy cows.** *J. Dairy Sci.* 23. 564-5. 1940. [Univ. Tennessee] **201**

Alfalfa, cut in the early bloom stage, and *Lespedeza sericea*, 12 to 15 in. high, were made into silage with molasses and phosphoric acid. Twelve cows were divided into 3 groups which all received alfalfa hay *ad libitum* and 10 lb. of a grain mixture ; the cows in the separate groups received in addition 20 lb. of corn silage, *Lespedeza* silage, or alfalfa silage. In 120 days the productions on these three rations were 12,599, 11,470 and 13,277 lb. of milk and 555.5, 506.5 and 566.8 lb. of butterfat respectively. [D. S. A.]

IDAHO UNIVERSITY, Agricultural Experiment Station. Bull. 214. **Sweet clover silage as a feed for dairy cows.** By *F. W. Atkeson* and *G. C. Anderson*. 1935. pp. 2-11. **202**

IDAHO UNIVERSITY Agricultural Experiment Station Bull. 215. **Sunflower silage for milk production.** By *F. W. Atkeson*. 1935. pp. 8. **203**

On the basis of total digestible nutrients consumed and milk produced sunflower silage was equal to maize silage. Palatability tests showed that the cows preferred the latter, but when no choice was given they ate the same amount of sunflower as of maize silage. [N. A. and R.]

ILLINOIS Agricultural Experiment Station. Bull. 494. **Yields of corn hybrids harvested for silage and methods to determine best time to harvest.** By *W. B. Nevens* and *G. H. Dungan*. 1942. pp. 387-412. **204**

Illinois corn hybrids and commercial corn hybrids (*Zea mays*) are superior to open-pollinated corn for silage purposes because of their greater yield of forage on a dry matter basis, the higher proportion of ears in the crop, and a greater lodging resistance. The best hybrids to use for silage in central Illinois are Illinois Hybrids 206, 448 and 863.

Corn should be harvested for silage when it has reached a dry matter content of 30 per cent ; if above 35 per cent it does not keep well. The dry matter content of the leaves is a reliable index of the dry matter content of the whole crop ; the ears are higher and the stalks lower than the leaves in dry matter. A method of determining dry matter content is given in an appendix. Between 1935 and 1941 the area planted to hybrid corn had increased from 0.42 per cent to 87 per cent of the total corn acreage in Illinois.

IMBS, B. [**Wild plants of the Steppe zone as raw material for silage.**] *Sovhoz. Proizvodstvo*. No. 8. 43-4. 1943. [Stavropol Inst. Agric.] **205**

This is a plea for the rational wartime use of enormous stands of *Artemisia* spp., *Melilotus* sp., and weeds for the preparation of silage that contains sufficient amounts of vitamin A to feed to sheep. Some species of *Artemisia* contain 1.50-1.57 kg. of digestible protein (1) and 20.07-26.52 feeding units (2) per each 100 kg., whereas the corresponding figures in the case of maize are 0.60 kg. and 19.80 of (1) and (2) respectively. To obtain a good silage from *Artemisia*, which is generally low in moisture, one should add water to increase it by 20-25 per cent by comparison with fresh plants. Ewes in the second half of pregnancy (or young growing stock) when given a daily ration of 1.5-2 kg. silage, gained as much weight as those which were fed, in addition to silage, with 200-250 grm. of hay. The expenditure of nutrients to ensure 1 kg. gain of weight was also approximately the same in both groups of sheep.

IMBS, B. G., and SINICYN, A. M. [**The common wild herbage plants of the dry steppe and semi-desert as material for silage and sheep fodder.**] [Contained in :] Symposium of scientific papers on feeding of sheep. Vorošilovsk, 1939. pp. 122-9. **206**

The authors studied the nutritive value of silage from (1) *Artemisia austriaca*, (2) *A. maritima*, (3) *A. scoparia*, (4) *Erigeron canadensis*, (5) *Melilotus officinalis*, and (6) *M. alba*, and the suitability of these plants for the preparation of silage. The estimated yields, in centners per ha., were 11.7, 18.9, 13.1, 44.3 and 77.9 for (1) (2) (4) and (5) + (6) respectively. Sheep readily consumed all the above silages. Yet those prepared with an admixture of 25-30 per cent *Sorghum* were more acceptable (85-100 per cent of the daily ration) than those prepared from the above plants alone (60-70 per cent). Each 100 kg. of silage prepared from (1), (3). (5), (5) + *Sorghum*, and (6) contained 1.57 and 15.92 kg. of digestible protein and starch equivalents respectively. The increase of live weight of in-lamb ewes and of young stock, and the live weight of newly-born lambs were greater among the animals fed on silage than among those that received a ration of the steppe hay alone.

ISAACHSEN, H. Konservering av friskt for. [**Conservation of green crops.**] *Nord. Jordbr Forskn. Kongresberetn.* 1935. 744-51. **207**

An account is given of a number of experiments on the ensiling of turnip tops, potatoes and different green crops, made during the years 1921 to 1935 at the Agricultural College, Norway. Tables give average composition, digestibility coefficients, the computed nutritive value and the losses in conservation of the different feeding materials. Experiments on artificial drying are also reported. [N. A. and R.]

ISLE OF MAN, Board of Agriculture. Inc. Food Prod. Adv. Leafl. No 6. **Silage from autumn grass.** 1941. pp. 4. [Exp. Farm, Peel] **208**

Silage from young grass, being rich in protein, is an excellent substitute for cakes and meals for winter stock-feeding. If suitably treated with fertilizers a good growth of hay aftermath and autumn grass may be obtained to make silage. Advice is given on the use of silos and ensiling. An example of the cost is also given. Other substitutes recommended are " seeds " hay and pulses.

JOURNAL OF THE DEPARTMENT OF AGRICULTURE, EIRE. **Potato silage.** *J. Dep. Agric., Eire.* 38. 80-4. 1941. **209**

Potato silage consists of cooked potatoes stored in a suitable receptacle until required. It is recommended for farm stock, especially pigs, in place of concentrates.

KANNENBERG, H. Die Entgiftung des *Equisetum palustre* durch Warmvergärung. [**Removal of the poisonous principle from Equisetum palustre by high temperature ensilage.**] *Rep. 3rd Grassl. Conf. Zürich.* 1934. 411-8. [English summary, 418.] [Neu-Hammerstein, Germany] **210**

Ensiling at high temperature (65-80°C.) destroys the poisonous principle, so that grass containing a certain amount of this weed can be used as cattle fodder.

KANSAS Agricultural Experiment Station. Bull. 217. **Alfalfa silage.** By *O. E. Reed* and *J. B. Fitch.* 1917. pp. 19. **211**

KATKOV, B. [**The cultivation of silage crops in the steppes of the Trans-Volga region.**] *Sovhoz. Proizvod.* No. 3. pp. 19-21. 1944. **212**

The region is dry and in some parts irrigation is practised. Methods of cultivating the following forage crops are described : sunflower, maize, sorgho, watermelon, and pumpkin.

KERLE, W. D. **Sunflowers. A possible sideline.** *Agric. Gaz. N. S. W.* 51. 479-81. 1940. **213**

Information regarding soil and climatic requirements, fertilizers, soil preparation and sowing, harvesting, varieties, and use (for green fodder and as ensilage).

KIRSCH, W., HILDEBRANDT, H., and LEMKE, K. Die Erträge der Ackerbohne als Silofutter in verschiedenen Vegetationsstadien, verglichen mit den Erträgen bei Feldtrocknung. [**Field beans as a silage crop ; their yield at different stages of growth compared with yield when dried.**] *Georgine* 108. 522-3. 1931. **214**

Trials have been conducted for some time at the Animal Breeding Institute of Königsberg University on the value of field beans as a silage crop. The results appeared in articles by Hildebrandt and Kirsch respectively, *Georgine* 107, Nos. 23 and 75, 1930, and showed that field beans not only furnish a valuable silage fodder rich in protein and superior to turnips and maize, but are particularly valuable in that they may be used before complete maturity is reached.

The trials now described were conducted with a view to ascertaining the nutritive value of beans at various stages of development and when dried in the ordinary manner in the field. From analyses made at different stages the following conclusions are drawn :

With the aid of the cold fermentation process it is possible to obtain a considerably higher yield of digestible nutriment by harvesting at the stage described as " silage maturity," that is when the seed is fully developed, the plant is still green, and the lower leaves are dying off, than when the plants are allowed to become fully ripe and are dried in the field. Silage from beans cut at this stage is not only the most nutritive, but also the most palatable. A further advantage is that the field is set free comparatively early, and a winter cereal crop may be grown subsequently, the beans serving as a preparatory crop.

Kleinberg, A. Pěstování silážních rostlin v suchých oblastech. [**Growing plants for ensilage in dry regions.**] *Časové Otáz. Zeměd.* 1936. No. 56. 122-5. **215**

Although sunflower is poorer in nutrients it produces higher yields than maize (up to 600 q. per ha.), is more drought resistant, but requires heavy manuring. It should be harvested in the milky stage of ripeness and crushed by blunt knives before putting in silos. Maize on the contrary furnishes more nutrients if cut half-ripe. Of clovers, *Trifolium incarnatum* is the easiest to conserve in silos without addition of sugar or acids. Hairy vetch/cereal winter mixtures are perfectly reliable even in the driest conditions.

Knodt, C. B., Sprague, V. G., Williams, P. S., and Autrey, K. M. **The evaluation of several grass-legume mixtures for grass silage and aftermath grazing.** *J. Dairy Sci.* 30. 573-4. 1947. [Dept. Dairy Husb., Pennsylvania State Coll.] **216**

One of the most important pasture problems in the Northeastern United States is to provide nutritious herbage during midsummer. Since permanent pastures provide adequate grazing during the spring, the first crop from semi-permanent pasture is most valuable for hay or silage and the aftermath is grazed. In an effort to obtain information on the relative productivity of five

associations of grasses and legumes throughout the midsummer months, three replicate plots of approximately 0.3 acre in size of each of the associations were seeded in the spring of 1944. The first crop was harvested for silage when the grass was in the early head stage in the ladino associations and from the alfalfa plots when the legume was in about the one-tenth bloom stage. The aftermath from all plots was grazed rotationally. The frequency of grazing was determined by the amount of herbage present on an individual plot and its stage of growth, irrespective of the condition of the other replicates or plots of the other associations in the study.

The digestible nutrient production from grazing of the various plots was determined by calculation of maintenance requirements, gains and losses in body weight, milk production, and barn feed intake of the cows while they grazed each plot according to the methods recommended by the Joint Pasture Committee. The following digestible nutrient production was obtained from the various associations during the first 2 years of the experiment (expressed as pounds of digestible nutrients per acre) :

	Grass-legume association	Silage	Grazing	Total
I.	*Dactylis glomerata*/ladino clover	2055	2439	4494
II.	*Dactylis glomerata*/alfalfa	2201	3212	5413
III.	Bromegrass/alfalfa	3022	1730	4752
IV.	Bromegrass/ladino clover	2260	1826	4086
V.	Timothy grass/ladino clover .	2386	1900	4286

The 2-years averages obtained suggest that the brome grass-alfalfa combination excelled in production of silage and that the *Dactylis*-alfalfa and *Dactylis*-ladino clover associations provided the greater aftermath grazing. However, a statistical analysis of the data failed to reveal significant differences. [D.S.A.]

KOENEKAMP, A. Was hat der Landwirt beim Anbau von Sonnenblumen zur Gärfutterbereitung zu beachten ? [**What must be taken into consideration in growing sunflowers for ensilage** ?] *Mitt. dtsch. LandwGes.* 47. 225-7. 1932. [Inst. Grünlandwitrschaft. d. Landw. Versuchs- u. Forschungsanst., Landsberg, Warthe] **217**

The growing of sunflowers is particularly recommended for farms on light land in a dry climate, and it is suggested that in East Germany in particular this crop may be of great help in the solution of the fodder problem. The questions of variety, manner of sowing and growing, harrowing, manuring, mowing, and ensilage are gone

into fully, and a description is given of feeding trials which prove the nutritive value of sunflowers.

RRISHNAN, T. S. **Silage investigations at Bangalore. III. Effect of the stage of maturity on the ensilage of Jowar.** *Agric. Livestock Ind.* 2. 507-14. 1932. [Animal Nutr. Section, Bangalore] **218**

The "prime stage" produces the best silage with the least losses. It is more profitable to ensile the straw than to use the quite unsuitable immature plant.

KRISTENSEN, R. K. Ensileringsforsøg. IV. 1924-32. [**Ensiling trials. IV. 1924-32.**] *Tidsskr. Planteavl* 45. 623-39. 1941. **219**

In trials with sugar beet tops and sugar beet waste in silos and earth pits, the loss of dry matter was greater when ensiling was carried out in earth pits. Cutting of the beet tops caused a remarkable improvement in quality and greatly reduced the loss of dry matter. Good silage of such plants as lucerne and lupin can be produced if the material is chopped and moisture content of the plants is not too large during ensiling.

KRONACHER, C., and KLIESCH, J. Luzerne silage und junges Leguminosen-Grünfutter als eiweisssparendes Zufutter bei der Kartoffelmast. [**Lucerne silage and young leguminous fodder as a protein saving supplement in fattening on potatoes.**] *Züchtungskunde* 10. 136-8. 1935. **220**

A control group of pigs was given steamed or ensiled potatoes *ad lib.* with a concentrate mixture, 1 kg. per head daily, containing 220 g. digestible protein. The experimental groups were fed increasing quantities of silage or green fodder with the same concentrate mixture for the first 7 weeks. Thereafter the mixture was changed to one with a higher protein content (320 g. per kg.) so that the difference in protein content between the control ration and the silage or green fodder was made up when 0.5 kg. per head was fed. This resulted in a saving of concentrates and cost of production was reduced. The average consumption of silage or green fodder was 2.5 kg. per head daily, giving 50 g. digestible protein. [N. A. and R.]

LINDAHL, I., DAVIS, R. E., and ELLIS, N. R. **Effect of temperature and length of storage on ensilage made from cooked white potatoes.** *J. anim. Sci.* 5. 279-84. 1946. [United States Dept. Agric.] **221**

Cooked potatoes can be ensiled and the silage stored for at least a year. The silage is very palatable and when fed in a balanced diet it has a high feeding value for pigs. On account of the heavy loss of nutrients during the fermentation the most suitable temperature during this period is about 60°F

LIVESAY, E. A., VANLANDINGHAM, A. H., and SCHNEIDER, B. H. **Corn silage studies.** *Proc. Amer. Soc. Anim. Prod.* 33rd Ann. Meeting. 126-30. 1940. [W. Virginia Agric. Expt. Sta.] **222**

A comparison of normal corn silage (ears on), stover silage (ears removed), and ear silage.

LOWE, H. **Acidification of beet leaves in silos.** *Zuckerrübenbau* 15. No. 11, 175-80. 1933. **223**

MACKIE, J. **Silage.** *Scot. Agric.* 27. 188-90. 1948. [Bent, Laurencekirk] **224**

Suggestions on the management of grass for silage-making are given. It is good practice to graze the 1st year, cut once the 2nd and 3rd years, and cut three times the 4th year before ploughing up. The importance of adequate manuring and rolling of the grass is stressed. Pit silos, ensiling tools, and the removal of silage from a pit are also discussed.

MALOCH, M. Vhodné odrůdy kukuřice pro pěstování na siláž [**Maize varieties for ensilage.**] *Čsl. Zeměd.* 20. 123-4. 1938. [Inst. Forage Crops, State Agric. Exp. Sta., Košice] **225**

The maize varieties tested are classified according to results of twenty-six experiments with nineteen varieties carried out in the years 1929-1932 and 1936-1937 in twelve places of Slovakia and Subcarpathian Ruthenia. Their yields of green and dry matter are given. The Czechoslovakian varieties proved very satisfactory.

MANSFIELD, W. S. **Autumn-sown silage crops.** *J. Minist. Agric.* 48. 69-71. 1941. [Sch. Agric., Cambridge] **226**

The crops considered include vetch/rye mixture, rye, winter oats and field beans.

MASSACHUSETTS Agricultural Experiment Station. Bull. No. 362. **Haying in the rain. A study of grass silage.** By *J. G. Archibald* and *C. H. Parsons.* 1939. pp. 19. **227**

The ensiling of grasses and legumes has reached the practical stage and is being adopted by an increasing number of farmers in the eastern United States. For the present, the use of molasses as a preservative seems to be the most economical method, although phosphoric acid may also be used. This Bulletin gives full details of the preparation and feeding value of grass silage. It is doubtful whether it will or should replace ordinary haymaking entirely ; it will be of most value for late summer feed when pastures are short, and on heavy low-lying land better suited to grass than to corn (maize).

MASSACHUSETTS Agricultural Experiment Station. Bull. 425. **Grass silage.** By *J. G. Archibald* and *C. H. Parsons*. 1945. pp. 11 **228**

Silage can be made without any preservative by wilting the crop to the proper moisture content, but where this procedure is impracticable some form of preservative is necessary for grasses and legumes but not for corn and small grains. Suitable preservatives are molasses (minimum amount 60 lb. per ton of green material) or ground cereal grain at the rate of about 150 lb. per ton. Urea, lactic acid cultures and salt are not satisfactory.

Harvesting methods, control of seepage and the composition of silage made from various crops are discussed. Principal changes in composition as a result of ensiling are a decrease in protein and carbohydrates and a corresponding increase in crude fat and fibre. Ensilage of potatoes is not recommended.

MIHIN, A. M., FOKIN, V. M., and TUPIKOVA, A. A. [**The preservation of green vegetable masses having a low moisture content.**] *Problemy Životnovodstvo, U.S.S.R.* No. 5, 74-94. 1936. **229**

MISSOURI Agricultural Experiment Station. Circ. 239. **Filling the silo with corn or sorghum.** By *J. E. Comfort*. 1942. pp. 4. **230**

Corn (*Zea mays*) and *Sorghum* made into silage provide greater feeding value than when fed as dry fodder. The best time for cutting corn for silage is when 90 per cent of the kernels have dented and most of them have hardened. At this stage the lower leaves are turning yellow or brown but the stalk is still full of sap. The moisture content of the corn should be about 70 per cent. The sorghums should be cut for silage when the heads are mature and the seeds hard. If harvested earlier, a silage with a high acid content is produced. Should it be necessary to refill the silo with dry corn fodder a fairly satisfactory silage can be made by adding an equal weight of water sprinkled over the chopped material. The method of cutting and hauling the fodder and of filling the silo are described; there is a paragraph on ensilage cutters and their operation.

MONTANA STATE COLLEGE Agricultural Experiment Station. Bull. 317. **Pea vine silage as a feed for dairy cattle. Feeding trials.** By *J. O. Tretsvan*. 1936. pp. 11. **231**

In experiments with milking cows and growing heifers good grade pea vine silage was readily eaten and replaced part of the hay ration without detrimental results. It was worth approximately one-third the value of good alfalfa hay. The silage has a strong odour and flavour and should be fed in moderate quantities after milking and preferably out of doors. Weedy, badly cured or spoiled silage from the outside of the stack should not be fed. About 5 tons of good silage were produced per acre. [N. A. and R.]

MOORE, H. I. **Ensilage problems in farm practice.** *J. Minist. Agric.* 54. 385-9. 1947. [Univ. Leeds] **232**

High-quality grass silage is a valuable protein-rich food on which stock thrive well. When silage is properly handled, loss of nutrients is much less than in haymaking. Silage-making need not interfere with farm routine, since the grass should be cut long before the hay season, and it may supersede the growing of turnips. Ordinary farm equipment can be used to handle silage. Objections by workers to handling the product are exaggerated. [N. A. and R.]

MOORE, H. I. **Good silage replaces concentrates.** *Dairy Farmer* 21. 11. 1948. [Agric. Dept. Univ. Leeds] **233**

Arable silage is usually made from mixtures of cereals with legumes, a common combination being oats, peas and tares. Unfortunately analysis of such silage shows that instead of 15 per cent or more crude protein in the dry matter it is often only 11 per cent. It can therefore be classed only as a maintenance food instead of a production food capable of replacing difficult-to-get purchased concentrates. The reason is that the protein in arable silage depends primarily on the proportion of cereal to legume and on the stage of maturity of the crop when cut. Legumes have a somewhat higher analysis of protein than cereals, which difference is most marked in the later stages of growth, e.g. the greater the proportion of oats the lower the feeding value of the product. Cutting of the crop should be arranged to give maximum yield of protein per acre even though there is some sacrifice of crop yield per acre. Other hints for the successful production of quality arable silage include (1) the use of the binder and a low loading trailer to spread up the task and so maintain the quality of the product, (2) the use of molasses (equal parts of molasses and water at 2 gallons per ton of crop) to ensure good fermentation, (3) ensuring that each three-foot layer of silage attains a minimum of 90 degrees F., (4) a good seal of soil or dung to keep out the air and then a covering of straw to make the silo ranproof.

MOORE, H. I., and WILLCOX, J. S. **Quality in cereal-legume silage.** *J. Minist. Agric.* 51. 502-7. 1945. [Univ. Leeds] **234**

For maximum production of protein per acre in a silage mixture of cereals and legumes, the crop should be cut at the flower-emergence stage. The protein content of the silage will be influenced not only by the time of cutting but also by the content of legume in the mixture. Tares have given consistently high figures for protein and have not fallen off so sharply in protein content with advancing age as the other crops.

It is realized that these results are from one trial only, conducted during one season, but the figures obtained seem to merit the consideration of farmers at a time such as the present when the problem of supplying stock with adequate amounts of protein from home-grown crops is of the utmost importance. The trial is to be repeated on similar lines during the coming season at three centres in Yorkshire.

MOORE, H. I., and WILLCOX, J. S. **Kale silage in clamps.** *J. Minist. Agric.* 53. 148-50. 1946. [Univ. Leeds] **235**

Three reasons for the decline of silage making in recent years are (1) the large amount of waste involved, (2) the high requirement of labour, and (3) the frequency with which a low protein product is obtained. This article indicates how the production of kale silage in clamps overcomes these problems.

NEAL, W. M., and BECKER, R. B. **A type of laboratory silo and its use with Crotalaria.** *J. agric. Res.* 47. 617-25. 1933. [Florida Agric. Expt. Sta.] **236**

As the climatic conditions of Florida render hay-making uncertain, investigations were undertaken to determine the relative values of various species of *Crotalaria* for ensiling purposes. The pit type of silo was used, with caps of cut forage and earth, and they were constructed on a hill-side with good surface drainage. The following species of plants were tested: *Crotalaria spectabilis*, *C. striata*, *C. intermedia* and *C. incana*. Of these species *C. striata* was refused by all the animals on which it was tried. The ensilage compares favourably with that of other crops as regards chemical changes and loss of nutrients, but before any recommendations are made for the use of *Crotalaria* in silage further feeding tests are necessary.

NEAL, W. M., BECKER, R. B., and ARNOLD, P. T. D. **The digestible nutrients of Napier grass and Crotalaria intermedia silages, Natal grass hay, and the dried refuses of grapefruit and orange canneries.** *J. agric. Res.* 51. 173-6. 1935. [Dept. Animal Hus., Florida Agric. Exp. Sta.] **237**

Where tropical and subtropical forage crops are grown, the summer rainy season causes difficulties in hay curing, with the result that increasing amounts of forage are being conserved as silage. One new type of feed is the dried refuse from the citrus canning plants. The results are presented of a study to determine the composition, coefficients of digestibility and digestible nutrients of silages made from Napier grass (*Pennisetum purpureum*), *Crotalaria intermedia*, Natal grass (*Tricholaena rosea*) and dried refuse from grapefruit and orange canneries.

NEVENS, W. B., and KUHLMAN, A. F. **Alfalfa silage.** *J. Dairy Sci.* 19. 611-7. 1936. [Univ. of Illinois, Urbana, Ill.] **238**

Whey powder, blackstrap cane feeding molasses, lactic acid starter and Bulgaric culture were used as preservatives in making the experimental alfalfa silage. All of these caused an increase in the acid content of the silage and whey powder was the most effective. A good silage was made by mixing chopped green corn, harvested at an early stage, with chopped alfalfa hay. It is concluded that a dry matter content of 39 per cent is about the upper limit for the successful ensiling of alfalfa alone. Alfalfa silage is very palatable to dairy cows but has a laxative effect. [N. A. and R.]

NEW JERSEY Agricultural Experiment Station. Circ. 374. **Timothy silage as a dairy feed.** By *C. B. Bender* and *H. H. Tucker.* 1937. pp. 7. **239**

Timothy hay cut at the usual stage of maturity is a poor quality roughage for dairy cattle, is low in portein, vitamin A and Ca, is relatively unpalatable and has a constipating effect on the cow. The results of field and feeding trials indicate that these criticisms do not apply to timothy silage (molasses). The material was palatable and of fairly high protein content. The carotene content was also high. The cost per ton was less than for maize silage under local conditions. [N. A. and R.]

NEW JERSEY Agricultural Experiment Station. Circ. 386. **Grass silage—its place in agriculture.** By *C. B. Bender* and *E. S. Savage.* 1939. **240**

NEW YORK STATE COLLEGE OF AGRICULTURE. Cornell Extens. Bull. 570. War Emer. Bull. 74. **Making silage from hay and pasture.** By *J. K. Wilson, E. S. Savage* and *G. H. Serviss.* 1943. pp. 4. **241**

The principles and practice of ensilage are discussed.

NIESCHLAG, F. Einsäuerung von Kartoffeln mit Zuckerrüben und Runkelrüben. [**Ensiling of potatoes with sugar beet and mangolds**] *Z. Schweinez.* 45. 682-3. 1938. **242**

The making of silage from a mixture of potatoes and mangolds or sugar beet is described. A mixture of 4 to 5 parts potatoes with 1 part mangolds or sugar beet (by weight) is recommended. [N. A. and R.]

NORSK LANDBRUK. Særskilt omløp for AIV fôr. Vil ikke dette være på sin plass også på mange norske gårdsbruk ? [**A special**

rotation of crops for AIV fodder. Will this not be appropriate also on many Norwegian farms ?] *NorskLandbr.* 7. 697-9. 1941. **243**

Review of an article by a Finnish investigator, I. Aikkinen, Valio, Helsingfors, describing special rotation to produce clover-timothy grass and leguminous green fodder for conservation as AIV fodder.

NORTHERN IRELAND, Monthly Report of the Ministry of Agriculture. **Silage for self-sufficiency. 1. Why make silage**? *Mon. Rep. Minist. Agric. N. Ire.* **22.** 322-4. 1948. **244**

This is the first of a series of three articles on silage in which the justification for making silage is discussed and hints are given regarding the construction of a suitable silo for the average farm. Many types of erect containers, both circular and square, have been found satisfactory as silos but the main objection to them is that the work of forking grass into a high structure and trampling it by foot is heavy and tiresome. The main features which should be incorporated in an erect container are : (a) it should be as high as possible—at least 10 feet ; (b) the inner surfaces of the walls should slope outwards from the bottom to the extent of 1 in. for each 2 ft. of height ; (c) the surface of the walls should be perfectly smooth ; and (d) the corners of square or rectangular silos should be well rounded.

The pit silo is preferred by most farmers because the material can be consolidated more effectively and with less labour by using a horse or tractor. The pit should be sunk 3 ft. in the ground and the concrete side walls raised 3 ft. above ground level so that the total depth is 6 ft. Such a pit should be 1 ft. narrower at the bottom than at the top ; 12 ft. wide at the bottom and 13 ft. at the top are suitable dimensions. A silo of this width and 6 ft. deep will hold about 1.5 tons of silage in each foot of its length. The surface of the side walls should be made perfectly smooth. A concrete floor is not necessary in dry soils but would be an advantage in stiff clays.

It is estimated that about 3 tons of silage will be required for each head of stock for the period mid-January to mid-April. One acre of good grassland properly manured will yield from 4 to 6 tons of high-protein silage, or from 8 to 12 tons of low-protein silage. One ton of silage occupies about 50 cu. ft. of silo space.

NORTHERN IRELAND, Monthly Report of the Ministry of Agriculture. **Silage for self-sufficiency. II. Material for making into silage.** *Mon. Rep. Minist. Agric. N. Ire.* 22. 354-6. 1948. **245**

This is the second of a series of articles on the general topic " Silage for self-sufficiency " in which the production of suitable material to ensile is explained. For the production of high protein herbage from grassland it is suggested that pastures with a good sole

of grass and clover and well supplied with lime be selected. They should be dressed early in March with a mixture of 3 cwt. superphosphate and 1 cwt. muriate of potash. The manured pastures should be fairly closely grazed during the first week of May. The droppings of the cattle should be spread, by chain harrow if necessary, and then 2 cwt. per acre of nitro-chalk or sulphate of ammonia applied. For stock which do not require a high protein food, it is necessary to obtain the maximum yield per acre of herbage which is still leafy and sufficiently succulent to be easily packed into the silo. Notes are given for those who decide to grow an arable crop for silage. A suitable seeds mixture for two or more cuts for silage or for one cut for silage and subsequent grazings is 6 stones* oats, 4 stones rye, 3 stones vetches or maple peas and 2 stones of Italian ryegrass.

ODLAND, T. E., COX, T. R., and SMITH, J. B. **A comparison of different crops for grass silage by the use of mason jars as miniature silos.** *J. Amer. Soc. Agron.* 33. 304-13. 1941. [Rhode Is. Agric. Exp. Sta., Kingston] **246**

Two-quart mason jars were successfully employed as miniature silos. Both molasses and phosphoric acid were satisfactory as preservatives; the amount of preservative is apparently of less importance than the moisture content and stage of maturity of the material ensiled. When different crops were ensiled at various stages of maturity, a decrease in protein content with increase in maturity of the crop was noted. Clover and alfalfa ensiled before blooming did not make as satisfactory silage as when allowed to reach full bloom. Clover, alfalfa, and soybeans made silage with a high protein content and generally excellent quality when harvested at the usual stage of maturity for hay. They were also used as parts of mixtures with other crops with good results. Millet, Sudan grass, rye, timothy, and Kentucky bluegrass were other crops satisfactorily ensiled by these methods.

OKLAHOMA Agricultural Experiment Station. Bull. 115. **Sudan grass silage.** By *C. K. Francis* and *W. G. Friedeman*. 1917. pp. 2-8. **247**

OLDERSHAW, A. W. **Silage made from oats and tares as a food for milking cows.** *J. Bd Agric.* 23. 224-9. 1916. **248**

OLDERSHAW, A. W. **Silage crops.** *J. Minist. Agric.* 31. 640-7. 1924. **249**

* 1 stone = 14 lb.

O'Loan, J. **Grass silage.** *J. Dep. Agric. Éire* 41. 313-6. 1944. **250**

In the past, summer grass, stored as hay, had to be supplemented with concentrated foods for dairy cattle throughout the winter. Only the scarcity of imported concentrates has popularized the making of good grass silage to preserve full feeding value. The desirable qualities of appearance and feeding value of silage, made by different processes, are outlined. The protective value of silage against disease has been evident.

Oregon Agricultural Experiment Station Bull. 194. **Oats and vetch versus corn or sunflowers for silage.** By *R. C. Jones.* 1922. pp. 20. **251**

Oregon Agricultural Experiment Station. Bull. 350. **Effect of agricultural and home economics research on Oregon's agricultural progress. A report of activities and accomplishments for biennium ending June 30, 1936.** p. 85. (New way of making silage, p. 22.) 1937. **252**

Experiments are under way for comparing silage made from alfalfa, oats and vetch, and Reed's canary grass. To one series of silos 2 per cent by weight of molasses was added. To another series 2 per cent molasses and a mixture of phosphoric and sulphuric acids were added. Thus far, palatability tests have not shown any appreciable difference for the treated silage. Complete chemical analyses are not available.

Paterson, D. D. **Ensilage investigations with tropical forages.** *Trop. Agriculture, Trin.* 22. 43-8. 1945. [Dept. Agric., Imp. Coll. Trop. Agric., Trinidad] **253**

The chemical composition of fresh and ensiled material of the following is given (a) grasses at different stages of growth : *Tripsacum laxum, Saccharum sinense, Brachiaria mutica* and *Pennisetum purpureum* ; (b) a legume/grass mixture of *Phaseolus mungo* (8 weeks old, in flower) and *T. laxum* (7 weeks old) in varying proportions ; and (c) *Ph. mungo* (10 weeks old in flower). The manufacture of silage by the low temperature fermentation process from tropical forage in the rainy season is practicable. Only young nutritious forage with a dry matter content of 20 per cent or more should be ensiled, and a legume-grass mixture of from 1 : 4 to 1 : 1 has advantages over silage from grass alone.

Paterson, W. G. R. **War-time stock feeding. Some investigations and lessons therefrom.** *Trans. Highl. agric. Soc. Scot.* 53. 26-48. 1941. [W. Scot. Agric. Coll., Glasgow] **254**

The use of silage in securing a measure of self-sufficiency by replacing the need for concentrates.

PERKINS, A. E., HAYDEN, C. C., KRAUSS, W. E., WASHBURN, R. G., and MONROE, C. F. **The preservation and feeding of carrots as combination silages.** *Bi-m. Bull. Ohio agric. Exp. Sta.* 29. 10-14. 1944. [Wooster, Ohio] **255**

Satisfactory silage was made from a mixture of 1 part of carrots (leaves and roots) and 2¼ parts of over-ripe maize. The object was to maintain the yellow colour in milk at a high level in winter. In spite of the low carotene content of the maize used, the average carotene content of the silage was 104.5 p.p.m on the dry matter. When fed at about 40 lb. per cow daily, in conjunction with lucerne hay and a concentrate mixture, milk and butterfat yields were similar to those obtained when ordinary maize silage was fed. Butterfat from two groups of cows on the maize-carrot silage contained an average of 5.20 and 4.95 p.p.m. of carotene compared with 3.96 and 4.86 p.p.m. in butterfat from cows fed ordinary maize silage. [D. S. A.]

PERKINS, A. E., HAYDEN, C. C., MONROE, C. F., KRAUSS, W. E., and WASHBURN, R. G. **Making silage from hay crops.** *Bi-m. Bull. Ohio agric. Exp. Sta* .No. 190. 3-12. 1938. **256**

PERKINS, A. E., and MONROE, C. F. **Apple pomace silage.** *Bi-m. Bull. Ohio agric. Exp. Sta.* 20. 154-8. 1935. [Wooster, Ohio] **257**

Observations regarding storage, keeping quality and feeding value are made and its use in amounts of 20 to 30 lb. daily as part of a good dairy ration is recommended. No feeding experiments have been conducted. [N. A. and R.]

PRATT, A. D. **Peppergrass silage.** *J. Dairy Sci.* 27. 365-7. 1944. [Virginia Agric. Exp. Sta., Blacksburg] **258**

Ensiling *Lepidium virginicum* using molasses as a preservative produced a palatable silage which after fermentation had no peppergrass flavour. Neither cream nor butter produced from the milk of cows fed on this silage showed any off-flavour. Peppergrass seeds did not germinate two weeks after ensiling.

PRESTHEGGE, K. AIV-fôr av fôrbeteblad til slaktegriser. [**AIV-fodder of mangold leaves for bacon pigs.**] *Meld. Norg. Landbr-Højsk.* 24. 469-501. [English and German summaries, pp. 497-501.] 1944. **259**

As far as the production of grain is concerned, digestible nutrients in the silage possess the same value for pigs as for ruminants. Roughly silage of leaves from *Beta vulgaris* var. has 80-85 per cent of the feed unit value for pigs and about 50 per cent of the protein value for ruminants.

REESTMAN, A. J. Onderzoek naar de waarde van groen ingekuild aardappelloof als veevoeder. [**The value of green ensiled potato haulms as cattle fodder.**] *Landbouwk. Tijdschr.* 55. 366-73. 1943. [Central Inst. agric. Res., Wageningen, Holland] **260**

Ensiling potato haulms without the addition of acid does not give good results. [N. A. and R.]

REEVES, M. L. M. **Cost of cereal-legume and grass silage.** *Farm Economist* 4. 17-20. 1942. [Agric. Advisory Dept., Univ. Manchester] **261**

RHODE ISLAND Agricultural Experiment Station. Bull. 257. **Corn varieties for silage in Rhode Island.** By *T. E. Odland* and *H. C. Knoblauch.* 1936. 14. [Rhode Island Agric. Exp. Sta., Kingston, R.I.] **262**

In a comparative study of one late-maturing, three medium-maturing and four early-maturing varieties of silage maize, it was found that the late type produced the highest yield of green matter per acre. Comparison of the eight varieties for the yield of dry matter per acre showed a slight advantage in favour of the late-maturing type. On the basis of total nutrients produced per acre medium-maturing varieties are equal if not superior to the late type. Results indicate that yields from early varieties are too low for silage purposes. It is suggested that for local conditions a variety which attains the dough stage of maturity by silage cutting time would be most suitable.

RICHARDSON, H. E. **The handling, processing and storing of legume crops for feed.** *Agric. Engng. St. Joseph, Mich.* 16. 469-71. 1935. [Res. Engineer, Papec Machine Co.] **263**

The field expense saved through storing *Medicago* material without curing is offset by the added expense of loading and hauling moisture-laden hay. On the basis of studies in Ohio and other States it is assumed that chopped alfalfa, regardless of moisture content, can be placed in storage at a cost not exceeding that of storing whole hay. Methods which have been used for the reduction of field and storage losses are reviewed and include the AIV and low-temperature processes. The latter would appear to be the most promising for meeting the immediate needs of the average farmer. Legumes containing more than 25 per cent moisture require treatment by mineral acids or high available carbohydrate materials such as molasses. Fifty pounds of molasses per ton of unwilted legumes is satisfactory. The advantages of artificially cured hay over field-cured, and types of dehydrators are items noted.

RIEDE, W., and REWALD, B. **Soybean investigations (Germany) 1930.** *Landw. Versuchs. Sta.* 113. 83-92. 1931. **264**

ROLOFS, E. A. **A method for preserving raw nettles.** *Problemy Zhivotnovodstva* 1935. Nos. 4-5. 154-9. **265**

Experiments with silage of nettles proved unsatisfactory. After various attempts a method was found which allowed not only nettles but various other forage crops to be preserved with the nettles. The formic acid in the nettles acted as a preservative.

Small scale experiments with nettles alone were first carried out in glass jars. Larger scale experiments on a semi-industrial scale were then carried out in barrels with (a) nettles only, (b) 60 per cent nettles + 40 per cent nettles and 60 per cent sugar beet leaves. The green stuff was well pressed down by trampling, covered with a wooden cover, a thermometer inserted through it and the whole top covered with wet clay, with a weight to keep the lid in position. All three barrels were opened after 63 days and the contents were found to be in a perfect state of preservation. When fed to milk cows the material was eaten with avidity.

These preparations were called " grass preserves " as distinct from silage. It is claimed that it is possible to prepare foodstuffs by this method from materials which are not easily silaged, and also to increase the protein in raw material containing low amounts by adding nettles which are rich in protein.

No fermentation occurs in this process and therefore no loss of nutrient materials.

It is noted, however, that there are many difficulties in the way before " grass preserves " can be produced on an economical scale, one of the problems being the difficulty of uncovering a container without the contents going bad. [N. A. and R.]

ROUND, P. **Fodder conservation.** *Qd agric. J.* 57. 231-3. 1943. **266**

The merits of ensiled *Sorghum* are discussed and there is information on yields and comparative costs.

SAYER, W. **Berseem as green fodder, hay and silage.** *Agric. Livestock Ind.* 4. 21-8. 1934. [Imp. Inst. agric. Res., Pusa] **267**

A large surplus of green fodder of berseem (*Trifolium alexandrinum*) is always available at Pusa from the second and third cuts. This was generally made into hay and stored for summer feeding, but in view of certain difficulties attending this procedure, tests were made on its conversion into silage. Green berseem can be made into silage of excellent quality without appreciable loss of value. Oat straw and green oats can be used as absorbents with advantage, the berseem and the oats to be placed in the silo in alternate layers. Berseem from all cuts may be used, but that from

the March and April cuts is lower in water content and gives better value. By using berseem green, as hay or as silage, the fodder requirements of stock throughout the year can be fully met.

SCHARRER, K., and NEBELSIEK, H. Versuche über Gärfutterbereitung mit Lampes krausblättriger Futtermalve und über die Verdaulichkeit des Gärfutters bei Schafen. [**Silage from Lampe's curly-leaved fodder mallow and digestibility of the silage by sheep.**] *Z. Tierernahr. Futtermittelk.* 3. 15-26. 1940. [Agrik. Chem. Inst., Univ. Giessen] **268**

Six lots of silage were made in concrete silos, 2 with equal parts of mallow and maize plus 0.3 or 0.5 per cent of biosil, and 4 with equal parts of mallow and beet leaves, of which 1 had no preservative and the other 3 had 0.25, 0.5 and 1.0 per cent of biosil. The 2 lots of silage made from the mallow and beet leaves with no preservative and with 0.25 per cent of biosil were unsatisfactory and were not used. Digestibility trials with sheep on the other 4 lots showed that the mallow-maize silages had, on a dry matter basis, 4.96 and 4.82 per cent of digestible true proteins and starch values of 40.0 and 49.5 respectively. The two lots of mallow beet leaf silage with the higher percentages of preservative had 7.38 and 9.49 per cent of digestible true protein and starch values of 42.6 and 40.0. [N. A. and R.]

SCHMIDT, K. **Preserving of young green feeds.** *Leopoldina* 2. 107-16. 1926. **269**

SCHUMANN, H. Untersuchungen über die Einordnung der Gärfutterbereitung in den Wirtschaftsbetrieb, unter besonderer Berücksichtigung ostpreussischer Verhältnisse. [**Influence of the introduction of ensilage on the farming system, with special reference to East Prussian conditions.**] *Landw. Jb.* 82. 1-92. 1935. **270**

Conditions on 10 East Prussian farms of 4 different types were studied. In general the effect on farms of the extensive, highly stocked type was to increase the head of livestock, whereas under more intensive conditions the effect was shown rather in improvement of feeding and reduction in the use of concentrates. In most cases the silage crop replaced other crops on the existing cultivated area, and, with two exceptions only, the total area devoted to consumption crops was appreciably reduced. On the whole, the area under grain crops tended to increase rather than to diminish, whilst the opposite was the case with the area devoted to roots for consumption. There was in every case a definite qualitative improvement in the total of home grown fodder, both as regards protein and starch equivalent. This showed itself in marked improvement in

milk yield, apart from the increase in the number of milk cows. The crop most frequently used for silage was second cut clover. Good results were obtained in the ensiling of marrow stem kale. [N. A. and R.]

SHUEY, G. A. **Legume silage.** Tennessee Agric. Exp. Sta. 52nd Annual Report. 1940. pp. 23-6. **271**

SKERMAN, P. J. **Silage from sugar cane tops.** *Qd. agric. J.* 55. 391-2. 1941. [Qd. Agric. Coll.] **272**

SVOBODA, F. Příspěvek k technice silážování bramborů. [**Technique of ensiling of potatoes.**] *Sborn. čsl. Akad. Zeměd.* 12. 430-6. 1937. **273**

SVOBODA, F. Kotâzce vhodné doby skilizně silážní kukuřice. [**Suitable harvest time for ensilage maize.**] *Čsl. Zeměd.* 20. 289-90. 1938. [Inst. Anim. Biotech., State Agric. Expt. Sta., Praha] **274**

The results of an experiment with maize harvested at four different dates at Liblice, South Bohemia, show that the nutrient content of maize is highest in the stage of yellow ripeness (0.74 per cent digestible protein and 16.16 per cent starch units). In this stage it also furnished the best ensilage. The fibre content rose only in the final ripening stage.

SWANSON, C. O., and TAGUE, E. L. **Chemical studies in making alfalfa silage.** *J. agric. Res.* 10. 275-92. 1917. **275**

TENNESSEE Agricultural Experiment Station, Annual Rept. 1938. **Winter pastures versus silage.** p. 83. [Knoxville, Tenn.] **276**

All the cows were fed the usual grain ration and as much alfalfa hay as they would eat. Those which received pasture whenever the ground was firm enough showed a slightly higher profit above feed cost than those which received silage instead. [D. S. A.]

TENNESSEE Agricultural Experiment Station, Annual Rept. 1938. **All-year pasture for dairy cattle.** pp. 87-8. [Knoxville, Tenn.] **277**

Dairy cattle fed all-year pasture, alfalfa hay, and silage have produced 85 per cent as much milk as cows fed a full-grain ration in addition to the same pasture and roughage. Several cows have been milked for five lactations without grain. [D. S. A.]

TIEMANN. Gestaltung des Futterbaues in Silowirtschaften. [**Form of forage crop cultivation in silo-farming.**] *Landw. Fachpr. Tschechosl.* 13. 49-50. 1935. [Institut für Grünlandwirtschaft, Tschechnitz bei Breslau] **278**

The author describes the technique of cultivation and suitability for ensiling of some forage crops. A questionnaire circulated to 40 farmers has shown that sufficient forage crops as a main crop should be produced on every farm to supply 25-30 kg. of sappy fodder (beet or beet leaves) and 5 kg. of hay per head per day throughout the winter. Grass hay should be prepared by hot fermentation (60-65°C.). Favourable results have been obtained in eastern Germany in recent years with ensilage prepared from potato stems and leaves, maize, sunflowers, *Helianthus tuberosus*, marrow stem kale, carrots, Sudan grass, soybeans and different fodder mixtures. Marrow stem kale produced a high yield of protein per ha. Soybeans failed altogether in the dry season of 1933. Fodder mixtures which are recommended include *Trifolium incarnatum* with winter vetch or *Vicia villosa*, or crimson clover and Italian ryegrass. The silos considered to be the most practicable are the ground silos of Pavlák in Czechoslovakia, and Tiemann, Völtz, Fingerling, Kuchler and others in Germany.

TIEMANN, and REHN. **Lupins as a silage crop for light soils.** *Futterkonservierung* 4. 19-25. 1933. **279**

TRAAEN, A. E. Ensilering og klomprotsmittee. [**Ensilage and club root infection.**] *Meld. Norg. LandbrHøisk.* 1940. 375-88. **280**

Club root, caused by *Plasmodiophora brassicae*, frequently results in rotting of the crop. Swede turnips were placed in ordinary silos, partly alone and partly together with tops, the AIV method being used. In addition some roots cut with a root rasp were put down. At the same time experiments were conducted in the laboratory. Ensiling a club-root infected crop according to the AIV method makes it possible to store fodder which otherwise would readily rot. Further the contagion in an infected crop is destroyed.

TRETSVAN, J. O. **Pea vine silage as a feed for dairy cattle.** *J. Dairy Sci.* 18. 438-9. 1935. **281**

TRUEMAN, J. M. **Silage crops other than corn.** *Agric. Gaz. Canad.* 6. 538-9. 1919. **282**

TRUSOV, M. S., and GLUBOKOV, T. P. [**Study of sunflower varieties as silage crops.**] *Social. Zern. Hoz.* 1934. No. 6. 163-79. **283**

Fifteen varieties of *Helianthus* can be classified into three groups in respect of total fodder yield. Late varieties are taller and more productive, but the data available are not sufficient to make a strict correlation between earliness and fodder yield possible. Hybrid varieties are superior in quality of fodder, whereas tall varieties are

hardly suitable for fodder purposes. Fodder yield was higher when harvested at milk ripeness as compared with full flowering ; the increase in the yield varies from 15 to 123 per cent with the variety. The analysis of the quality of fodder showed that a postponement of harvesting until the milk-ripe stage cannot be recommended, for the percentage of leaves is reduced, and the increase in the weight of fodder is mainly due to the increase of flower heads.

TUCKER, H. H. **Improving milk color.** *Guernsey Breed. J.* 55 279 and 281-2. 1939. [Agric. Exp. Sta., New Brunswick, N.J.] **284**

Silage was made from chopped mixed carrots (whole plant) and corn. [D. S. A.]

ULVESLI, O. AIV-surfôr av fôrbeteblad. [**AIV-fodder of mangold leaves.**] *Meld. Norg. LandbrHøjsk.* 21. 181-216. [English and German summaries, pp. 211-5.] 1941. **285**

The mean chemical content of the AIV fodder was as follows (in grm. per 100 grm.)

	In feed	In dry matter
Dry matter	20.3	——
Organic ,,	14.0	69.0
Crude protein	3.0	14.8
True protein	2.0	9.9
Fat	0.7	3.5
N-free extracts	7.2	35.5
Fibre	3.1	15.2
Ash	6.3	31.0
Ca	0.42	2.06
P	0.04	0.18

UNITED STATES, Department of Agriculture. Techn. Bull. 352. **Sudan grass as hay, silage and pasture for dairy cattle.** By *J. R. Dawson, R. R. Graves,* and *A. G. van Horn.* 1933. pp. 28. **286**

UNITED STATES, Department of Agriculture. Tech. Bull. No. 914. **Methods of making potato silage and tests of its feeding value for dairy cows.** By *J. B. Shepherd, T. E. Woodward,* and *C. G. Melin.* 1946. pp. 14. **287**

The best silages were obtained when potatoes were ensiled with 20 to 25 per cent hay. Such silages looked like good grass silage but were heavier ; they had a pleasant odour and a pH range of 4.42 to 5.28, and were eaten greedily. Cows maintained milk production and increased body weight.

Silages of potatoes alone or with 3 per cent corn meal or with 0.75 per cent salt were not satisfactory. They contained no carotene, were low in fibre and fat, and there was an excessively high loss of protein and dry matter. They had an offensive odour and a pH range of 4.05 to 4.15.

Potatoes may be ensiled with other farm crops such as corn or sorghum provided that not more than 500 lb. potato is put in with 1 ton of green crop. Potato silage can be made in trench or tower silos. Both types should be well drained so that seepage can escape. The quantity of potato silage fed should be limited to 4 lb. daily per 100 lb. live weight.

UPPSALA, Jordbrukstekniska Föreningen. Medd. No. 78. Ensilering av foderpotatis. [**Ensiling of fodder potatoes.**] By *Y. Andersson* and *N. Berglund*. 1941. pp. 35. **288**

Ensiling of raw potatoes can be carried out when they are to be fed to cattle. Potatoes which have been boiled before ensiling can be used for all classes of animals. Questions dealt with include method of cooking, carrying out of ensiling, removing the fodder from the silo, and computed costs of potato ensiling.

VARDEHAUG, A. Potetsilo med hå i. [**Silage of potatoes and aftermath.**] *Norsk Landbr.* 14. 123-4. 1948. **289**

Silage was prepared from boiled potatoes and clover aftermath which had been passed through an ordinary chaff cutter. AIV acid was applied to the topmost layer only. The animals ate the silage readily and showed good production.

VERMONT Agricultural Experiment Station. Bull. 434. **Legume and grass silages.** By *O. M. Camburn, H. B. Ellenberger, J. A. Newlander* and *C. H. Jones*. 1938. pp. 41. **290**

A discussion of methods of making legume and grass silage with or without the addition of molasses, to which is appended the report of a survey of practical operations throughout the north-eastern United States.

WAECHTER, v. Säuert Kartoffeln, die zur Fütterung bestimmt sind, ein ! Die Herstellung von Sauerkartoffeln. [**Ensile potatoes for feeding purposes. Preparation of potato silage.**] *Z. Schweinez.* 41. 741-3. 1934. **291**

WAHLEN, F. T., and WAGNER, S. Sortenanbauversuche mit Silomais. 1930-32. [**Variety trials of maize for silage, 1930-32.**] *Landw. Jahrb. Schweiz.* 48. 1-19. 1934. [Eidg. Landw. Versuchsanst., Oerlikon, Zürich] **292**

Five Swiss (three Rheinthal, Linth maize, and Nostrano) and four foreign varieties (Baden, Alsatian, and Bosnian varieties and Leaming, from Canada) were tried in eight localities. The characters and behaviour of each variety in various respects are described. The indigenous Nostrano and Linth maize gave the best all-round results, and, together with the Rheinthal, afford good material for selection.

WANGERIN, A. Das Einsäuern von Grünroggen. [**The ensilage of green rye.**] *Mitt. Landw.* 55. 333. 1940. [Kolberg, Pomerania] **293**

It is stated that, in addition to the Landsberg mixture, green rye in a mixture with winter vetch provides the best material for the silo. In the case of green rye more than in that of the other plants mentioned it is important to cut at the right time. The article consists mostly of technical advice for the packing of the silo.

WARD, C. T., WATSON, S. J., and FERGUSON, W. S. **Value of grass silage to a small holder.** *J. Minist. Agric.* 39. 224-8. 1932. **294**

Notes on the preparation, use and cost of production of grass silage.

WATSON, S. J. **The conservation of forage crops with special reference to grass.** *Emp. J. exp. Agric.* 7. 43-50. 1939. [I.C.I. Agric. Res. Sta., Jealott's Hill, Bracknell, Berks.] **295**

The subject is considered in regard to nutrient losses in conservation, vitamin content, nutrient concentration in conservation products and the present position of haymaking, artificial drying and ensilage. Ensiling is complementary to haymaking and should provide a fodder with dry matter of higher feeding value than hay. The process is of value also in grassland improvement by allowing the removal of surplus growth before the sward deteriorates.

WATSON, S. J. **The role of silage in grassland management.** *J. British Grassl. Soc.* 1. 36-40. 1946. **296**

There is normally at least one period of the year when growth from grasslands is at its maximum and if it cannot be controlled at this time deterioration sets in. " The ensilage process is a useful weapon in the control of the sward ; if we are to make the most of our grassland it is essential that the process comes into its own."

WATSON, S. J. **The preservation of protein without drying.** *Farming* 2. 137-9. 1948. [East of Scot. Coll. Agric.] **297**

The two processes, haymaking and ensilage, for the conservation of the more bulky protein foods are described. Haymaking is fraught with the possibility of great losses of protein and of vitamin

value if care is not taken and every effort made to reduce the wastage. Ensilage, on the other hand is a much more efficient method of conserving protein for winter use because the process is independent of the weather. The crop can be cut at an early state of growth while it is still leafy and rich in protein and vitamins. The view is expressed that if better methods of haymaking are adopted (stakes with cross bars, tripods, hurdles or fences) and ensilage widely practised, the protein supply of the average farm could be raised to a level which could make it almost independent of purchased foodstuffs.

WILSON, H. F., SRIVASTAVA, A. S., HULL, W. B., BETHEIL, J., and LARDY, H. A. **DDT residues on pea vines and canned peas from fields treated with DDT dusts.** *J. econ. Ent.* 39. 806-9. 1946. [Wisconsin Agric. Exp. Sta.] **298**

Data are given for the amounts of DDT residues recovered from pea vines, shelled peas, canned peas and pea vine silage after different rates of application of DDT.

WINDHEUSER, C. Der Anbauwert von Topinambur als Silopflanze. [**The value of Helianthus tuberosus as a silage plant.**] *Mitt. deuts. LandwGes.* 47. 657-8. 1932. [Württ. Landesversuchsanst. landw. Chemie, Hohenheim] **299**

Reference is made to the trials conducted by Bünger and Glet at Kiel (*Herb. Abst.* 2. 249. 1932) and trials at Hohenheim are described, the results of which were equally satisfactory. The green weight obtained at Hohenheim was somewhat greater, probably owing to different soil and climatic conditions, and above all different manurial treatment. The method of ensilage employed is described, and the chemical content of the silage is analysed, the nutriment obtained per hectare being deducted from this analysis. The author recommends the topinambour as a silage crop for districts in which maize does not thrive. A footnote to the article, written by Koch on behalf of the D.L.G. (German Agricultural Association) recommends caution in the adoption of this new crop, referring to objections raised by a practical farmer in 1873, when a previous attempt was made to introduce it. A further footnote contains Windheuser's reply to these objections.

WINKLER, H. Förstaårsvallens klöveråterväxt bör i första hand beredas till AIV-fodder. [**The clover aftermath of the first year ley should primarily be converted into AIV fodder.**] *Lantm. Svenskt Land* 27. 779-80. 1943. **300**

The clover-rich aftermath on the first year leys with its high protein content should be converted into AIV fodder for winter feeding, while the aftermath on the older leys, composed largely

of grass species, should be grazed. The advantages of AIV ensiling and artificial drying are emphasized.

WINKLER, H. Blastavhuggningsförsök i potatis. [**Experiments in cutting off potato tops.**] *Lantm. Svenskt Land* 26. 748-9. 1945. **301**

The growth of the tubers (at any rate of late and medium-late varieties) continues in Sweden during the whole of September or as long as the tops remain green. This autumn (1942) the fodder situation is better than a year ago, so that cutting of potato tops before the tubers are quite mature is not recommended. If the tops are then healthy and green they should be converted into AIV silage.

WOHLBIER, W. **Experiments in making lupin silage.** *Futterkonservierung.* 5. 1-18. 1933. **302**

WOOD, A. L. **Marrow-stem kale silage.** *J. Minist. Agric.* 50. 315-7. 1943. [Guisley, Leeds] **303**

This crop is of high nutritive value for milk production and is capable of giving as much starch equivalent per acre as a good crop of mangolds and more than twice as much protein. For silage the crop must be grown on well-cultivated land which has been heavily supplied with farm manure in the autumn or spring along with phosphates and liberal dressings of nitrogen. There is information on sowing, ensiling methods and construction of the silo.

WOODWARD, T. E. **Silage from the hay crops.** *Proc. Amer. Soc. Anim. Prod.* 32nd Ann. Meeting. 287-90. 1939. [U. S. Dept. Agric.] **304**

All silages, if they are properly made, have a high content of carotene and they are relished by livestock. Our own experience based on a number of feeding trials is that dairy cows will eat as much dry matter in the form of silage as they will in the form of hay and that, on the basis of dry-matter content, the silage is fully equal in nutritive value to the best field-cured hay that could have been made from the crop. Silages from the hay crops appear to be not quite as valuable pound for pound as corn silage, although the moisture content will affect the nutritive value of both kinds of silage. On the basis of average analyses, the total digestible nutrient content of grass or legumes silage with about 66 per cent moisture is equal to average corn silage with about 72 per cent of moisture.

WOODWARD, T. E. **Relation of agronomic and nutritional factors to engineering problems and farm practices in making grass silage.**

Agric. Engng., St. Joseph, Mich. 22. 54-6. 1941. [Bur. Dairy Ind., U.S., Dept. Agric.] **305**

A comprehensive discussion of the place of hay-crop silage in the production and storage of forage crops.

WRAGG, S. R. **Observations on quality silage.** *Farm Economist* 4. 21-3. 1942. [Dept. Econ., Harper Adams Agric. Coll., Newport, Shropshire] **306**

WRIGHT, P. A., and SHAW, R. H. **A study of ensiling a mixture of Sudan grass with a legume.** *J. agric Res.* 28. 255-9. 1924. **307**

VAN WYK, H. P. D., and VERBEEK, W. A. **Lucerne hay and lucerne silage for fattening oxen.** *Fmg S. Afr.* 20. 533-6. 1945. [Vaalhartz Res. Sta.] **308**

Fattening cattle could be successfully finished off on lucerne hay or lucerne silage supplemented with mealie meal. A mixture of the hay and silage produced better weight increase and carcase quality. [N. A. and R.]

ZAHNLEY, J. W., and FITCH, J. B. **Effect of ensiling on the viability of weed seeds.** *J. Amer. Soc. Agron.* 33. 816-22. 1941. [Kansas Agric. Expt. Sta.] **309**

Five out of the eleven species used showed some germination after storage in a silo, and it is concluded that the danger of spreading certain species by the agency of corn and silage crops is reduced but not eliminated by ensiling the crop.

ZEITSCHRIFT FÜR SCHWEINEZUCHT. Das Einmieten der Rüben. [**Ensiling beet.**] *Z. Schweinez.* 43. 651-3. 1936. **310**

The ensiling of mangels and sugar beet and their value and use as feeding stuffs are discussed. Modern varieties of mangel have almost the same nutritional value as sugar beet. Mangels may be dried or pickled but it is much less expensive to ensile them. The keeping qualities of mangels are greatly influenced by the type of soil in which they are grown and by the fertilizer used. Methods of ensiling are discussed. It is usually quite economical to dry sugar beet which yields about 25 per cent of its weight of dry matter. It is suggested that increased production of sugar beet and similar vegetables in Germany would provide a substitute for the 2 million tonnes of fodder grain at present imported into that country. [N. A. and R.]

ZHABOTINSKY, G. C., ORLOV, A. P., CHESNOKOV, V. A., and KOCHETKOV, P. S. **Ensilage of camel thorn under the conditions of middle Asia.** *Bull. U.S.S.R. Inst. Agric. Microbiol.* 7. No. 2. 103-36. 1935. **311**

E. FORAGE HARVESTING

AGRICULTURAL ENGINEERING RECORD. **Silage-making mechanization.** *Agric. Engng Rec.* 1946. 67-72. **312**

Ensiling includes cutting, loading, transporting and unloading into the silo. No single machine can perform all these operations, and the purchase of any one machine may do little towards reducing the overall man-hours required. As a result of investigations made in 1945 some general recommendations on the suitability of silage-making equipment for farms of average and larger size are made.

BESLEY, H. E., and HUMPHRIES, W. R. **Machines designed for harvesting and storing grass silage.** *Agric. Engng, St. Joseph, Mich.* **22.** 125-6. 1941. [N.J. Agric. Expt. Sta. (H.E.B.), and Bur. Agric. Chem. Eng, U.S. Dept. Agric. (W.R.H.).] **313**

Machinery for cutting, gathering, hauling, chopping, with notes on field choppers and elevators.

BOMFORD, D. R. **Machinery in modern farming.** *J. roy. Soc. Arts.* 91. 74-83. 1943. **314**

The labour involved in ensiling has prevented the process from becoming a general practice. Three measures which might be adopted for the making of grass silage have been put forward by A. Hosier.

DAVIDSON, J. B., SHEDD, C. K., and COLLINS, E. V. **Labor duty in the harvesting of ensilage.** *Agric. Engng, St. Joseph, Mich.* 24. 293-4. 1943. [Iowa State College (J.B.D.), Bur. Plant Ind. Soils and Agric. Eng., U.S.D.A. (C.K.S.), and Iowa Agric. Exp. Sta. (E.V.C.).] **315**

An analysis is given of time used in harvesting, cutting and loading of fodder for ensilage with recommendations for reducing labour and improving operating efficiency. Power and equipment expenditure have not been analysed.

DAVIES, C. **Cutting, loading and handling silage crops.** *J. Minist. Agric.* 54. 77-9. 1947. [Nat. Agric. Advisory Service, Cambridge] **316**

Special and expensive apparatus is not necessary for ensiling. If the instructions given are followed, it is considered that a well-filled silo can be a decided asset on a farm.

DUFFEE, F. W. **New developments in forage harvesting machines.** *Agric. Engng, St. Joseph, Mich.* **22.** 11-3 and 17. 1941. [Univ. Wisconsin] **317**

This discussion of machinery developed for harvesting grass silage, dry hay and straw behind the combine, and for the field harvesting of corn for ensilage, concludes with a detailed comparison of investment costs for old and new equipment, with or without the addition of a field corn ensilage attachment.

HAMLIN, F. H. **Grass silage harvesting methods.** *Agric. Engng, St. Joseph, Mich.* 19. 311-4. 1938. **318**

The harvesting, storing and feeding of uncured hay crops as silage offer important advantages over field-cured hay. Tables give the comparative costs of harvesting field-cured hay and grass silage. Details of the necessary equipment for handling heavy green crops are given. With improved harvesting methods grass silage may be expected to replace field-cured hay on livestock farms fairly rapidly. The advantages of replacing corn silage by hay crops are (1) heavy yields of green hay crops can be grown where corn will not succeed, (2) grasses and legumes are soil-conserving, and (3) heavy expense for ploughing and cultivating corn causes serious labour peaks on many farms.

NEW JERSEY Agricultural Experiment Station. Bull. 689. **Development of machinery for harvesting and storing grass silage.** By *H. E. Besley, C. Eby,* and *W. R. Humphries.* 1941. pp. 28. **319**

Grass silage in the Northeastern States includes a wide range of crops and combinations of crops, including legumes, cereals and grasses. Machines are on the market and others are under development for reducing the high labour requirement involved in putting up grass silage. Grain binders are used by some operators. Legume/grass crops for silage can be produced $2.50 per ton cheaper than corn for silage. Lower ensiling costs are associated with higher yields. Costs range from $1.66 to $2.22 per ton with respective yields of 10 and 6 tons per acre.

WRIGHT, S. J. **Farm implements and machinery.** *J. R. agric. Soc.* 106. 50-60. 1945. **320**

Following a review of works on general farm mechanization, there is discussion of hay and silage machinery and of grain harvesting and drying.

WRIGHT, S. J. **Recent developments in agricultural machinery.** *J. roy. Soc. Arts.* 94. 208-19. 1946. [Nat. Inst. Agric. Engng.] **321**

The paper includes discussion of tractor development, silage and hay-making machinery (e.g., the modern American forage harvester for cutting, chopping and loading maize for silage), and root harvesters. It is emphasized that the National Institute for Agricultural Engineering is not so much concerned with designing or making finished machines, but concentrates on the research aspects which will enable commercial firms to do the manufacture.

F. METHODS OF ENSILING FODDER

ALBADA, M. van. Proefnemingen over inkuilen. [**Silage experiments.**] *Versl. Landbouwk. Onderzoek* No. 52(4) B. 112-205. [English summaries, 160-2, 179, and 197-8; French summaries, 162-4, 179-80 and 198.] 1946. **322**

In a series of sixteen experiments a proprietary compound, composed largely of the acid sulphate, acid phosphate, and chloride of ammonia, was tested for its efficacy as a preservative in the ensiling of spring and autumn grass in comparison with other supplements, namely, AIV acid, hydrochloric acid, sodium chloride and ammonium hydrogen sulphate, and no supplement. Material treated with the proprietary compound was less reduced in bulk than under treatment with AIV acid or with no supplement, so that with the compound the amount of grass that could be ensiled was diminished. Although ammonia and butyric acid formation was probably slightly impeded and lactic acid content on an average somewhat higher in the compound-treated than in the no-supplement silage, loss of nutrient components in the silage made with the compound was great and at times approximated that in the no-supplement silage, so that in general the addition of the compound in the prescribed quantity of 1 per cent appears worthless.

The second series of experiments consisted of ensiling autumn grasses with solid carbonic acid. The principle involved is displacement of oxygen and therefore prevention of respiration and heating up. The method is very expensive but it opens up a new field for cold ensilage.

In the third series of experiments grass was ensiled with a supplement of molasses solution (4 kg. molasses to 100 kg. grass) in tower silos with press lids on the Schmidt system. Results were unsatisfactory. Nutritive value was low and only pigs would eat the silage. Costs were high. A simple earth cover is preferred.

Unchopped potato leaves and stems, without preservative, with addition of AIV-acid, and addition of molasses, were used in the fourth series of experiments. Results were unsatisfactory. Only the leaves were eaten by cattle, the stems being left. The failure was attributed to insufficient pressure making the preservatives ineffective. For good results one should chop the potato tops, add preservative, and use a well-closed silo. A heavier cover of earth is required for the ensilage of potato tops than for grass.

ARCHIBALD, J. G. **Studies in the chemistry of grass silage.** *J. agric. Res.* 72. 277-87. 1946. [Massachusetts Agric. Exp. Sta.] **323**

Investigations were undertaken to find a substitute for molasses as preservative in silage. Of seven preservatives tried, only molasses and ground wheat were effective. In chemical composition of the silages, variation due to the crop were more significant than those due to the preservative. Legume silages developed greater acidity than those made from grasses or small cereals ; the acidity was largely due to lactic and acetic acid while in grass silage it was largely butyric acid. Maize silage was strikingly different from grass silage having a higher pH value than grass silage and resembling legume silage in its high lactic acid and low butyric acid content. Fermentation caused greatest losses in carotene content.

ARTS, T. Ensileeren. [**Ensilage.**] *NaCoVo-boekje.* No. 4. 2nd edn. 1936. pp. 30. **324**

The first edition of this booklet was published in 1934. A brief, mimeographed English summary is furnished. The biological principles, advantages, disadvantages, and technique of ensilage by the following methods are discussed : (1) high temperature ensilage, also known as the Dutch or Friesian method ; (2) the cold ensilage process (Völtz) ; (3) the lukewarm or American tower ensilage process ; (4) ensilage with the addition of mineral acids, as in the AIV process ; (5) ensilage with the aid of other additions (NaCl, bacteria, sour dairy residues) ; (6) the carbonic acid process ; (7) combined methods. In the final discussion of the ensilage of different crops, it is noted that when clover-grass is ensiled by the high temperature process, 30 per cent of the starch equivalent and 60 to 65 per cent of the digestible protein are lost ; when the acid process is employed the respective losses are 15 and 15 to 20 per cent only.

BARTELS, A. M. M., and BOETTCHER, C. J. F. Inkuilproeven volgens de Finse methode en de vitasanmethode in Noord-Limburg 1943. [**Experiments in ensilage by the Finnish and Vitasan methods in North Limburg, 1943.**] 1947. pp. 27. [Roosendaal (A.M.M.B.), and Leiden (C.J.F.B.), Netherlands] **325**

In seventeen different localities nineteen ensilage trials compared the respective merits of the AIV process and one in which a compound named Vitasan is used ; in four additional trials Vitasan only was used. A total of 370 tons of material was ensiled, composed in each place of one of the following plants : lupins, clover, serradella, beet leaves, turnips, vetch, swedes. In four cases several of these plants were ensiled in layers, the layers being sampled separately. The silos were of a simple, bottomless type, ranging in capacity from 7.5 to 18.5 cub. m. Ensilage took place between 22 September and 12 November, 1943, sampling both before ensilage and some months later when it was desired to feed the silage to

stock. The samples were analysed by the Central Institute of Agricultural Research, Wageningen, and the results are presented in tabular form and discussed in relation to dry matter and protein content, coefficient of digestibility of the protein content of minerals and crude fibre ; the breaking down of the protein ; the pH value and the organic acids ; and losses of dry matter, protein, etc. Externally there was little difference between the two kinds of silage. The following chemical differences are noted : the Vitasan process does not require so low a pH value in order to get good results ; the Vitasan product has more butyric acid, without any apparent deleterious effect, and has at the same time a considerably higher content of minerals than the AIV product ; in regard to the breaking down of protein there were slight differences in favour of the AIV process. The value of the Vitasan process is held to be fully demonstrated. The product proved palatable, and the technique simpler than that of the AIV process.

BECHDEL, S. I. **Molasses silages equal in value.** Pennsylvania Agric. Exp. Sta. 53rd Annual Report. Bull. 399 (Science for the farmer.). 1940. pp. 6-7. **326**

BENDER, C. B., ARCHIBALD, J. G., BOHSTEDT, G., KNOTT, J. C., MONROE, C. F., and WOODWARD, T. E. **Committee report on silage methods, evaluations, etc.** *J. Dairy Sci.* 26. 213-5. 1943. **327**

BENDER, C. B., TUCKER, H. H., KRUEGER, W. C., PFAU, K. O., and FOX, A. S. **Molasses hay silage.** *J. Dairy Sci.* 19. 137-46. 1936. **328**

Ensiling of green grasses and legumes of high moisture content with 40 lb. of molasses per ton will produce a good palatable silage.

BETTINI, T. M. Esperienze di insilamento con sili a chiusura ermetica e con acidificazione. [**Results of ensiling in hermetically sealed silos and with acidification.**] *Riv. Zootec.* 15. 370-4, 376-80 and 382-3. 1938. [Ist. Zootec., Univ. Florence] **329**

The 3 methods of making silage which were investigated, namely, ensiling in hermetically sealed silos, treating with acid, and ensiling in hermetically sealed silos with the addition of Na metabisulphite, all gave satisfactory results with respect of preservation of material and conservation of nutritive value. The loss of organic substances and of minerals was, however, least in the first method. [N. A. and R.]

BEUTL, R. Die Silierfähigkeit verschiedener Grünfutterpflanzen. [**The suitability of different green crops for ensilage.**] *Landw.*

Fachpr. Tschechosl. 13. 75-6, 79-80 and 86-7. 1935. [Trautenau.] **330**

Several methods of ensiling are considered on the basis of 44 analyses of different types of silage (6 fodder mixtures, 10 meadow grass, 4 clover/grass, 5 clover, 4 maize, 8 maize with other crops, 6 forage beet in various combinations, and 1 *Helianthus tuberosus*). The methods considered are the use of molasses (1 per cent), salt (0.5 to 1.0 per cent) and the AIV acid method, the latter not being regarded as suitable. The relative merits of the cold (20-30°C.) and hot (40-50°C.) fermentation methods are considered. The author prefers the cold fermentation which is simpler. *Dactylis glomerata, Phleum pratense, Festuca pratensis* and *Phalaris arundinacea* are more suitable for silage than maize as they possess more dry matter. The optimal water content is 70-75 per cent. If the water content of the material is higher, 1 per cent of sugar or 2-3 per cent of ground or crushed rye should be added. Analysis of various types of silage showed that best results were to be obtained with meadow grass, grass/clover mixture and maize, and the poorest results with pure clover silage. The addition of sour skimmed milk to several mixtures had an unfavourable effect in most cases.

VAN BEYNUM, J., and PETTE, J. W. Bacteriologische onderzoekingen over ensileering met toevoeging van zure wei, ondermelk of suiker. [**Bacteriological investigations on silage from green forage with the addition of acid whey, skim-milk or sugar.**] *Versl. Landbouwk Onderzoek.* 1936. No. 42 (17) C. 735. **331**

The favourable effect of whey and skim milk on silage is caused by lactose, from which lactic acid is produced, and by its water content, which makes the silage homogeneous. The bacteria of the acid whey are of no importance. Even when as much as 20 per cent of whey is used, the increase in the sugar content, about 1 per cent, is not always sufficient. The experiments show that good effects can be obtained with cane sugar. A sugar solution should be used and not dry sugar. [N. A. and R.]

VAN BEYNUM, J., and PETTE, J. W. **Bacteriological examination of silages prepared in 1932 with the addition of inorganic acids.** *Versl. Landbouwk. Onderzoek.* 1933. No. 39C. 545-65. **332**

VAN BEYNUM, J., and PETTE, J. W. Resultaten van het bacteriologisch onderzoek van silages uit de praktijk, bereid met wei- of suikertoevoeging. [**Bacteriological study of silage made with whey or sugar.**] *Vereeniging Exploit. Proefzuivelboerderij te Hoorn, Ann. Rep.* 1936. 103-57. **333**

The upper limit of pH for successful lactic acid fermentation is 4.2. Above this level, lactic acid is converted to butyric acid and

the pH rises. Putrefactive changes with NH_2 formation then occur. Of 6 samples of grass silage made without addition, only 1 became stable at a pH below 4.2 ; of 17 samples of grass ensiled with sugar, 10 ; of 83 samples of grass and whey (4 to 5 per cent) silage, 35. Proportions of whey as high as 20 per cent are also unsatisfactory and, to ensure satisfactory results, much higher proportions of sugar may be necessary. [N. A. and R.]

BISMARCK, v. Verdorbene Sauerkartoffeln. [**Damaged potato silage.**] *Z. Schweinez.* 43. 697-8. 1936. **334**

The correct procedure for ensiling potatoes in earth pits is outlined. The pit should be so constructed that its walls are impermeable to water. It should be covered with clay. The potatoes should be thoroughly washed and closely packed to exclude air. The silo should be rapidly filled so that the potatoes do not have time to cool. The steaming of the potatoes should be adequate but not excessive. [N. A. and R.]

BOHSTEDT, G. **Nutritional values of hay and silage as affected by harvesting, processing, and storage.** *Agric. Engng, St. Joseph, Mich.* 25. 388, 390 and 392. 1944. [Univ. Wisconsin] **335**

In humid regions it is easier to preserve the nutrients of a forage crop by ensiling rather than by haymaking. The chemical processes involved, the function of preservatives and wilted crops, inoculation and use of salt are explained. The best single criterion of silage quality is its acidity which should be between pH 3.5 and 4.5. Maize and sorghum plus suitable legumes (soybean) are ideal silage crops. Methods of filling the silo and of storage which best preserve the nutrients are described, and the palatability of the product and its benefit to stock are discussed.

BOHSTEDT, G., PETERSON, W. H., and BAHLER, G. P. **Corn meal as a grass silage preservative.** *J. Dairy Sci.* 24. 513-4. 1941. [Univ. Wisconsin] **336**

BOHSTEDT, G., RUPEL, I. W., and KING, W. A. **Molasses-alfalfa silage gives fine results when made of good alfalfa.** Wisconsin Agric. Exp. Sta. Annual Report 1937-38. Part II. Bull. 443 (What's new in farm science) 1939. p. 85. [Madison, Wisc.] **337**

When cows ate 50 lb. of molasses-alfalfa silage or AIV alfalfa silage daily, or a standard winter ration, milk yields were comparable, the decline in production over 5 months being least in the cows receiving the molasses silage. Although the molasses silage contained only 2/3 as much vitamin A and carotene as the AIV silage there was little difference in concentration of these factors in the milks produced on these two rations. [D. S. A.]

BOYLE, C., and RYAN, J. J. **Experiments on grass silage.** *J. Dep. Agric. Irish Free St.* 33. 149-59. 1935. [Univ. Coll., Cork] **338**

In making grass silage by the AIV method in a wooden silo of the Finnish type, loss in dry matter due to respiration and fermentation was 7.3 per cent. The use of silage in replacing hay, roots and concentrates is noted, and the relative merits of three methods of conserving summer grass (the ordinary and AIV methods and that by which molasses are added) are discussed.

BRACCINI, P. L'infossamento dei foraggi col metodo Italo Giglioli. Esperimento con foglie di barbabietole. [**The ensilage of forage by the Italo Giglioli method. Experiment with beet leaves.**] *Nuovi. Ann. Agric.* 16. 167-80. 1936. [Fac. agrar., Univ. Milano] **339**

The I.G. method of making pit silage, evolved by Italo Giglioli in 1887 (Giglioli, I. Fermenti e microbi. Saggio di igiene antimicrobica. Naples, 1887. p. 399), is described. A solution of hydrochloric acid (in the author's experiment 10 per cent) is employed. The ensilage of beet leaves by this method is recommended. The silage has been well utilized by dairy cows.

BRÉTIGNIÈRE, L. L'ensilage des fourrages verts avec acidification. [**The ensilage of green fodder by means of acidification.**] *C. R. Acad. Agric. France.* 30. 467-8. 1944. **340**

The value of ensilage by means of using hydrochloric, sulphuric, formic or other acids has been demonstrated, but there still remain points to be elucidated, chiefly in regard to the nutritive value of the original fodder compared with the ensiled product.

BRIOUX, C. Conservation des fourrages verts par l'ensilage acide—résultats obtenus. [**Conservation of green fodder by acid ensilage—results obtained.**] *J. Agric. prat. Paris* 99. 435-7. 1935. **341**

BROUWER, E. Über die Ensilierung unter Zusatz von Molkereiabfallprodukten und über die Korrelation zwischen pH, Ammoniakzahl, Buttersäuregehalt und Geruch bei Grassilagen. [**Addition of dairy waste products in the preparation of silage. Correlation between pH, ammonia value, butyric acid content and odour in grass silage.**] *Biederm. Zbl. B. Tiernahr.* 9. 508-24. 1937. **342**

Grass and other silages made with additions of whey, buttermilk or separated milk proved in the main unsatisfactory. On the average the pH values decreased with falling moisture content and with fall in N content of dry matter. Rise in pH was accompanied by increase in NH_3 content. In the grass silage the butyric acid content was very low at pH 4.0 but above this point increased with rise in pH. [N. A. and R.]

BROUWER E., DE WILDT, J. C. DE R., and DIJKSTRA, N. D. Proefnemingen omtrent inkuiling met en zonder toevoeging van mineraal zuur en suiker. 3. [**Ensiling with and without addition of mineral acid and sugar. 3.**]

DE WILDT, J. C. DE R., BROUWER, E., and DIJKSTRA, N. D. Proefnemingen omtrent inkuiling met en zonder toevoeging van gezuurde wei of mineraal zuur plus suiker. 4. [**Ensiling with and without addition of sour whey or mineral acid and sugar. 4.**] *Versl. Ver. Proefzuiv. Hoorn* 1937 (1938) 1-48 and 259-304. **343**

Details are given of the changes in chemical composition (dry matter, N constituents, ether extract, fibre and ash), and of the losses from and quality of the silages made in different kinds of silo, with and without drainage. [N. A. and R.]

BROUWER, E., DE WILDT, J. C. DE R., HOLLEMAN, L. W. J., and FRENS, A. M. **Ensiling with and without the addition of HCl and sugar.** *Versl. Landbouwk. Onderzoek.* No. 39C, 401, 1933. **344**

BUCHNER, E. Mejores pastos. Ensilaje. [**Better herbage. Ensilage.**] *Campesino, Santiago de Chile.* 75. 187-8, 226-8. 1943. [Exp. Station of the Nat. Soc. Agriculture, Chile] **345**

An outline of technique.

BUENOS AIRES, División Técnica Extensiva de la Dirección de Agronomías Regionales. El método de ensilaje AIV. [**The AIV method of ensilage.**] *Almanaque Min. Agric. Argent.* 22. 293-4. 1947. **346**

A short account of the AIV ensilage process for the use of Argentine regional agricultural advisers.

BURKHARDT, E. Einsäuerung von eiweissreichem Grünfutter unter Zusatz von eingesäuerten Kartoffeln. [**Ensilage of protein-rich green fodder by means of adding ensiled potatoes.**] Diss. Jena. 1940. [Univ. Jena] **347**

Through a 40 per cent addition of ensiled potatoes a pH value of 4.65 was obtained in the upper layer of lucerne silage, the value in the lower layer being pH 4.25, so that the silage could be judged " fairly good " or " good " according to Gneist (*Forschungsdienst.* 8. 521. 1939.) Additions of 10 and 20 per cent ensiled potatoes gave pH values which admit a poor estimate only of the lucerne silage quality obtained.

CANADA, Department of Agriculture. Spec. Pamph. No. 66. **Making grass and legume silage without preservatives.** By *P. O. Ripley.* pp. 4. 1942. [Central Exp. Farm, Ottawa] **348**

CARLSSON, G. Tre års erfarenheter av beredning av och utfodring med AIV-foder vid Ultuna egendom. [**Three years experience in the preparation of and feeding with AIV fodder on the Ultuna estate.**] *Lantm. Svenskt Land* 19. 523-4. 1935. **349**

During the last three years the AIV method of ensiling has been utilized on the Ultuna estate, and the fodder fed to cattle with good results. It is important to follow exactly the instructions given. Particular care should be exercised in packing the material, and the acid should be uniformly distributed in the silo.

CASALIS, C. E. M. **Molasses silage process.** *Hoard's Dairyman* 79. 140-2. 1934. **350**

CASANOVAS, E. **Utilization of a by-product of the sugar industry molasses.** *Rev. facultad agron. univ. rep., Montevideo.* No. 20. 179-91. 1940. **351**

CHURCHILL, B. R., and HORWOOD, R. E. **Methods of making and feeding alfalfa molasses silage.** [Abs. of paper for 33rd Ann. Meeting, Amer. Dairy Sci. Assoc., June, 1938.] *J. Dairy Sci.* 21. 105-6. 1938. [Michigan State Coll.] **352**

CION, R., and KOBJAKOV, A. [**Acidophil silage**] *Soc. seljs. Hoz.* 1944. No. 7. p. 59. **353**

Experiments made in Siberia during 1942 showed that by adding a diluted (1:20) culture of acidophil bacteria in 1 litre skimmed milk to 1 ton of silage [unspecified] its quality was improved and more of the silage was consumed by live stock. The air-dried mass of such a silage had 4.06 per cent of lactic acid, only 1.6 per cent of butyric acetic acid and other harmful substances, and the moisture content was 6 per cent. The corresponding figures for the control silage were 2.7, 1.4 and 55 per cent, and the animals ate it unwillingly.

CRASEMANN, E. Die Technik der Silofutterbereitung. [**The technique of ensilage.**] *Schweiz. Cbl. Milchw.* No. 22. 1936. pp. 14. [Inst. f. Haustierernähr. d. Eidg. Tech. Hochsch., Zürich] **354**

CRICHTON, A. **The conservation of grass. Hay, silage or dried grass.** *Trans. Highl. agric. Soc. Scot.* 47. 50-63. 1935. [Rowett Inst., Aberdeen] **355**

A comparative study is made of the various methods now available for the conservation of grass for winter feeding. Under Scottish conditions of climate the most efficient methods appear to be (a) storage in tower silos and (b) a system of making hay on frames which permit of good ventilation (the Proctor Tripod system).

Artificially dried grass has a high nutritive value, and when the present high costs of the process have been reduced there will be great scope for the method in very rainy areas. The time of cutting is most important, as the protein content of grass is at its highest just prior to flowering, and the method most easily applicable in any district at that season will probably give the best results. [N. A. and R.]

CULLISON, A. E. **The use of urea in making silage from sweet sorghum.** *J. Anim. Sci.* 3. 59-62. 1944. [Dept. Anim. Husb., Mississippi Agric. Exp. Sta.] **356**

A prolonged fermentation time was noted when sweet sorghum was ensiled. This was attributed to the low N content of the plant. Addition of urea to the silage resulted in a normal fermentation time and the production of silage of a higher carotene content, greater palatability and feeding value than that made with sorghum alone. [From N. A. and R.]

VAN DAALEN, C. K. **Virtanen method for the conservation of fresh fodder.** *Landbouwk. Tijdschr.* 44. 637. 1932. **357**

DEPARDON, L., and BURON, P. A propos de l'ensilage à froid avec addition d'acide formique. [**On cold ensilage with the addition of formic acid.**] *C. R. Acad. Agric. France.* 30. 469-71. 1944. **358**

Experiments were made in France in the ensilage of " moah " [probably *Panicum italicum*], *Zea mays*, *Brassica napus* (leaves and roots), *Anthyllis vulneraria*, *Fagopyrum esculentum* and *Sinapis alba*, wherein 4 litres of a 5 per cent solution of formic acid were added to each 100 kg. fodder. Analyses made of the original material and of the final product are compared. The products were uniformly good on account of the relatively constant pH observed, an infinitely small quantity or even an absence of butryic acid, and the very marked predominance of lactic acid in the acidity produced. Where there was any loss of proteids and glucosides, it was insignificant. The effect on the dairy cows to which the silage was fed for 6 months was excellent.

DE WILDT, J. C. DE R. Investigations on silage preparation. VI. **Acidification by the addition of sugar.** *Versl. Landbouwk. Onderzoek.* No. 47.C, 897-918. 1941. **359**

DE WILDT, J. C. DE R., BROUWER, E., and DIJKSTRA, N. D. Proefnemingen omtrent inkuiling met en zonder toevoeging van mineral zuur. 2. [**Ensiling with and without addition of mineral acid. 2**] *Vereen. Exploit. Proefboerderij Hoorn. Ann. Rep.* 1933. (1934). 161-213. **360**

DE WILDT, J. C. DE R., BROUWER, E., and DIJKSTRA, N. D. **Ensiling experiments with and without addition of sour whey or mineral acid and sugar.** *Versl. RijkslandbProefst's, Grav.* No. 44, C, 477-522. 1938. **361**

DEUTSCHE LANDESKULTURZEITUNG. Bekanntmachung des Reichsnährstandes über die Einsäuerung von Grünfutter. [**Announcement of the Reichsnährstand concerning the ensilage of green fodder.**] *Dtsch. LandeskZtg.* 4. A. No. 1. 20-1. 1935. **362**

This article contains a résumé of fuller instructions which were published in *Mitt. Landw.* 49. 1140-2. 1934. It includes advice concerning the need for chopping, and for using sugar or chemical agents and air-tight covers. There is also an analysis of the feeding value of silage made from different plants, including grasses and legumes, cut at various stages.

DIJKSTRA, N. D. Iets over de principes van de verschillende inkuilingsmethodes. [**Some observations on the principles underlying the different methods of ensilage.**] *Maandbl. LandbVoorl-Dnst* 4. 297-305. 1947. [Agric. Exp. Sta., Hoorn, Netherlands] **363**

An account is given, from the chemical and bacterial viewpoints, of the advantages and disadvantages of the following ensilage processes: the so-called warm or Friesian process extensively employed in the north of the Netherlands, in which a high temperature is produced through layering loosely the slightly wilted material (grass is that mentioned) instead of stamping it down; the " cold " process, in which the moist material is firmly pressed down; the process in which the desired bacterial development is produced through the addition of sugars, notably in the form of molasses (at least 4 per cent molasses requisite in the case of grass); processes in which various acids are used, namely, a mixture of hydrochloric acid and sulphuric acid (the AIV process), formic acid, sulphuric acid (contained in two proprietary compounds), carbonic acid; the so-called Hardeland process for ensiling beet or potatoes, which are pulped, while any green material used is chopped, all being blown together into the silo; and finally the use of a recently produced proprietary compound of salts.

Faulty silage is generally due to an insufficient mixing of the material and the addition employed, whether molasses or acids. This is best overcome by the use of a watertight silo having a tap, the addition being applied in a very fluid form and in such quantity that the material remains saturated until the right stage of acidity has been reached, which will be in approximately 1.5 months. The fluid can then be drawn off, and this should be done before the silo is opened so that the silage is not fed too wet.

EKELUND, S. Grönfoderensileringens utveckling. Sammanställning av litteraturen 1939-44. [**Contributions in making herbage silage. A review of the literature for the years 1939-44.**] *K. LantbrAkad. Tidskr.* 84. 407-34. [English summary, pp. 428-9.] 1945. **364**

Comparison is made of results obtained from use of the AIV method, the admixture of carbohydrate, the formic acid method, and that of adding lactic acid.

ELTING, E. C. **Molasses as a preserving agent in making soybean silage.** *J. Dairy Sci.* 18. 440. 1935. **365**

The addition of 1 per cent by weight of molasses to soybeans cut in the early bloom stage produced palatable silage with no evident putrefaction. The dry matter content of the fresh material was 21.25 per cent and the loss of crude protein in ensiling was 15 per cent. No objectionable flavour or odour was imparted to the milk when the silage was fed to cows as the only roughage. [N. A. and R.]

ERDENBRECHER, A. H., and DÖRFELDT, W. **Acid ensilage of pressed beet slices of high sugar content.** *Z. Wirts. Zuckerindust.* 86. 289-321. 1936. **366**

Trials in earth-covered trenches and in small experimental vessels indicated that so-called sugar press-slices, containing about 26 per cent of dry matter, of which nearly half is sugar, yield a product superior in appearance and odour to that from ordinary exhausted beet slices containing about 17 per cent of dry matter and 0.6 per cent of sugar. The latter became pappy and their non-sugars underwent profound decomposition. The sugar press-slices preserved their shape; acidification was mainly at the expense of the sugar, and ceased before much decomposition of non-sugars had occurred, provided air was not admitted. Close packing and effective exclusion of air were necessary to restrict losses of dry matter; earth silos were not suitable. Addition of salts did not reduce losses, but addition of lactic bacteria and lactic acid proved beneficial. The nutritive value of the product has not yet been determined. [N. A and R.]

ERIKSSON, S. Skördetidens inflytande på förlusten vid AIV-foderberedning. [**Influence of time of cutting on loss in the preparation of AIV fodder.**] *Lantm. Svenskt Land* 29. 1048-9 and 1056. 1945. **367**

Experiments conducted in Sweden by the Institute of Animal Nutrition show that when ley fodder is cut at different stages of development and pre-dried to the same dry matter content, the loss during ensiling itself increases slightly with advanced development,

due to the fact that the fodder becomes coarser, for which reason compression is rendered more difficult. If the loss during pre-drying is also taken into account the difference between the different times of harvesting is insignificant. During ensiling, however, the break-down of protein increases slightly with delayed cutting.

If pre-drying of the fodder cannot be carried out, the delayed cutting entails an increased dry matter content and consequent reduction of ensiling loss. Then the loss with ensiling will be as in field drying. The gain from early cutting is accordingly then less than if pre-drying can be carried out.

FAGAN, T. W. and ASHTON, W. M. **The preservation of green fodder.** *Welsh J. Agric.* 13. 129-44. 1937. [Univ. Coll. Aberystwyth] **368**

Data are recorded on different methods of making silage from experiments carried out at the College Farm, Nantcellan, during 1932-1934. Chemical composition of green fodder, composed of mixtures of grasses and clovers, is compared in tabular form with that of ordinary pit silage and AIV silage. Considerable losses are incurred by both methods of preservation, but the chemical changes giving rise to these are greater by the ordinary than by the AIV process. A comparison of decomposition undergone by the material at the edge of the silos and at the centre shows the deleterious effect on nutritive value of the access of air.

Produce from an area of grassland, selected to provide grass for preservation as ordinary, AIV, molasses and Defu silage, has been analysed and shows that less mature material is better for ensiling as it is more easily and effectively packed ; a comparison of the loss of dry matter in silage and hay making shows that loss is greater in the latter than when similar material is made into molasses, Defu or AIV silage.

FYRILEIV, E. AIV vaeske-Myosil. En oversikt over de viktigste forsøkresultater. [**AIV liquid-Myosil. A review of the most important experimental results.**] *Norsk Landbr.* 10. 27-31. 1944. **369**

There is scarcely any difference in the loss of organic matter with the use of the two conservation liquids. In loss of protein there is probably a difference to the advantage of AIV liquid. The large content of ammonia in Myosil-conserved fodder points clearly in this direction. The butyric acid content is also slightly larger following the use of Myosil. Myosil-conserved fodder does not produce acidosis : neutralization of the fodder with basic mineral substances or feeding stuffs like roots and hay is therefore not necessary. The two feeds are equal in digestibility of organic matter. There is little likelihood of any difference in the digestibility of crude protein. Results of experiments and experience indicate

that the dry matter in Myosil-conserved fodder has greater nutritive value than in AIV liquid-conserved fodder.

FYRILEIV, E., and ULVESLI, O. Forsøk med AIV-surfôr og Myosil-surfôr. [**Trials with AIV acid fodder and Myosil acid fodder.**] *Norsk Landbr.* 11. 74-7 and 91-3. 1945. **370**

AIV solution conserves protein substances better than Myosil. On the other hand Myosil, unlike AIV solution, has no unfavourable effect on assimilation of minerals. Otherwise there is little difference in the value of the two ensiling liquids as fodder-conserving preparations, if Myosil's purely practical advantages in comparison with AIV solution be excepted.

GARNER, F. H., and SANDERS, H. G. **Grass silage.** *J. Minist. Agric.* 46. 57-62. 1939. [Sch. Agric. Cambridge] **371**

The technique of the manufacture of grass silage, especially with the help of molasses, is discussed from the practical point of view. [N. A. and R.]

GNEIST, K. Grünfuttersilierverfahren und Silofutteruntersuchungsmethoden. [**Methods of ensiling and analysis of green fodder silage.**] *Landw. VersSta.* 128. 257-366. 1937. **372**

For the analysis of silage the following recommendations are made. The estimation of total acetic and butyric acids is most accurately performed by the double distillation method. The pH value of the silage extract should be determined electrometrically. These two determinations obviate the necessity for determining free acetic and butyric acids. If a pH determination cannot be made then the free acids should be determined by Wiegner's method. The estimation of all free, water-soluble fatty acids is only of use when very badly made silage of pH > 4.8 is being examined. Determination of free lactic acid is omitted and a rapid method is outlined for the determination of total lactic acid. It is recommended to express all results on a dry matter basis.

From a comprehensive study of the ensiling, on a laboratory scale, of a large number of different green crops the following points emerge. Green fodder can only be safely ensiled by the cold fermentation process, without an addition, when the ratio of crude protein to N-free extractives is equal to or greater than 1: 2. Even then the pH will only reach 4.2 if the plant material is cut into short lengths (or possibly pulped) or moistened with water. If acid or molasses is added all plants with normal water content can be ensiled even if the crude protein : N-free extractives ratio is less than 1 : 2. The loss of CO_2 from fodder undergoing ensiling is very high if the temperature reaches 26-30°C. At 29°C. the loss is three times that at 18°C. and butyric acid is formed even with protein

poor fodder. At a pH< or = 4.2 the CO_2 loss normally corresponds to a loss of not more than 10 per cent of the digestible N-free extractives. Total lactic acid formation is rapid only in the first 10 days of ensiling. One half of the total acetic acid is usually formed in the first 3 weeks. Butyric acid formation is absent at pH<4.2 and at pH>4.2 sets in during the second month after ensiling. Amide formation takes place equally in well or poorly acidified silage but in the latter case the amides are further broken down to NH_3.

It is desirable to let any free juices run off from the silo as rapidly as possible and a suitable device for promoting this in the case of silos built into the ground is discussed. [N. A. and R.]

GNEIST, K. Verbesserungsmöglichkeiten bei der Kaltvergärung von Grünfutter. [**Possibilities of improving the cold silage of green fodder.**] *Forschungsdienst.* 17. 416-25. 1944. [Agric. Res. Inst., Bromberg] **373**

Laboratory experiments showed that crushing the material so that the cell walls of the plants are broken down gives better results than mere chopping. The content of digestible protein in the silage is 20 to 25 per cent greater when the material has been crushed; crushed material settles better in the silo, so that a saving of treading down, estimated at 70 per cent, is effected. The addition of 10 per cent steamed acidified potatoes to chopped lucerne, well mixed, produces a good silage. A 5 per cent addition might be enough if the lucerne were crushed. Suitable apparatus for crushing and mixing silage material on a large scale is needed.

GORINI, C. Über eine thermophile Milchsäureensilage. [**Lactic acid silage prepared by a thermophilic process.**] *Milchw. Forsch.* 19. 193-6. 1937. **374**

The process is discussed by which the development of the thermophilic microflora is enhanced and the advantages of the process over other methods of making silage are enumerated. [N. A. and R.]

GORINI, C. **Lactic silage with a pasteurized thermophile.** *Le Lait.* 18. 473-81. 1938. **375**

GORINI, C. Un ensilage lactique thermophile pasteurisé. [**A lactic acid silage pasteurized by a thermophilic method.**] *Le Lait.* 18. 673-81. 1938. [Milan] **376**

Attention is drawn to the excellent silage which is produced by the Falavigna process. The herbage is strongly compressed in a moist state to exclude all air, the fermentation becomes anaerobic and the temperature rises to 60-65°C. This encourages thermophilic lactic fermentation to the exclusion of butyric fermentation and a

high grade quality of silage is produced. The losses of organic matter in its production are not yet known. [N. A. and R.]

GRAHN, B., and HANSSON, A. AIV-kraftsaftfoder från egen torva. [**AIV-concentrated succulent fodder from the farmer's own grasslands.**] *Svenska Vall- o. MosskFören. Kvartalsskr.* 2. 243-63. 1940. **377**

Detailed instructions, illustrated by a large number of photographs, are given for the preparation of AIV silage. In many cases AIV fodder has caused a distinct improvement in the condition of domestic animals in their resistance to diseases, etc., because of the better conservation of vitamins by the AIV method, and because, in contrast to hay, the vitamin content remains constant during the whole period of storage ; year-old hay has a low vitamin content.

GUTERMANN, R. Erfahrungen bei der Konservierung von Weidegras nach dem Ansäuerungsverfahren. [**The conservation of pasture grass by the acidification process.**] *Rep. 3rd Grassl. Conf. Zürich.* 1934. 405-11. [English summary, 411.] [Munich, Germany] **378**

The German method of acidification has been found suitable, producing an excellent fodder of good quality and palatability, with no adverse effect on various dairy products.

HAGER. Mehrjährige Erfahrungen in der Rheinprovinz über die Einsäuerung von Grünfutter mit Hilfe von Säuren. [**Several years' experience in the Rhine Province in the ensilage of green fodder by means of acids.**] *Landw. VersSta.* 123. 88-96. 1935. [Bonn.] **379**

The material included grass, clover, forage mixtures and beet leaves. Optimal methods are outlined and different acids are compared.

HANSSON, N. AIV-fodrets bruksvärde och användbarhet. [**The value and usefulness of AIV-fodder.**] *Landtm. Svenskt Land.* 19. 99-101. 1935. **380**

HANSSON, N. Den holländska ensileringsmetodens brister. [**The defects of the Dutch method of ensiling.**] *Landtm. Svenskt Land.* 19. 516-7. 1935. **381**

HAYDEN, C. C., PERKINS, A. E., MONROE, C. F., KRAUSS, W. E., KNOOP, C. E., and WASHBURN, R. G. **Molasses treatment for meadow-crop silage.** *Bi-m. Bull. Ohio agric. Exp. Sta.* Vol. 30. No. 234. pp. 102-8. 1945. **382**

Cows' tastes do not always agree with man's judgement, but so far as man can judge the molasses-treated silages seem better in

quality than untreated silages. Quality of the silage is not further improved when the addition of molasses is increased above 40 lb. per ton. Addition of molasses is recommended when rapidly-growing crops with low dry-matter content are to be ensiled immediately after cutting.

HELLBERG, A. Vergleichende Versuche mit verschiedenen Methoden zur Einsäuerung des Weidefutters, insbesondere in Hinblick auf die Verwendbarkeit von Melasse als Zusatzmittel. [**Comparative trials of different methods of ensiling herbage, with special reference to the use of molasses.**] *Biederm. Zbl. B. Tierernähr.* 14. 375-416. 1942. [Agric. Coll. Sweden, Upsala.] **383**

The material comprised clover, grass, lucerne, weeds, and mixtures, at different stages of development. Laboratory experiments were conducted from 1939 to 1941 in the ensiling of this material by means of AIV solution, the proprietary compounds Amasil [formic acid] and Penthesta Red [SO_3], and molasses in varying quantity and dilution and also in mixture with AIV solution. A detailed presentation of the results obtained shows, among other things, the economic superiority of the use of molasses over that of the AIV method.

HELLBERG, A. Fosforsyrans värde som tillsatsmedel samt inflytandet av temperaturen och grönmassans torrsubstanshalt vid ensilering av vallfoder. [**The preservative value of phosphoric acid and the influence of temperature and dry matter content in the material in ensiling grassland crops.**] *K. LantbrAkad. Tidskr. Stockh.* 84. 139-79. [English summary, 177-9.] 1945. **384**

The experiments were carried out in 64-litre glass containers. The former problem was investigated in one trial where different amounts of phosphoric acid were added in two cases and where it was mixed with hydrochloric acid in two other cases. Comparisons were made with AIV solution and hydrochloric acid. The pH-value, the quality of silage, and the loss of nutrients were about the same in all cases except the one with the smaller amount of phosphoric acid, which resulted in the lowest quality and the greatest loss. The quantity of effluent was largest with hydrochloric acid and smallest with AIV solution. In the case of the larger amount of phosphoric acid, the phosphorus content was nearly nine times higher than when AIV solution and hydrochloric acid were added.

In three experiments the temperature was about 14, 20 and 29°C. in different containers. At each temperature silage was made with molasses and with AIV solution. The quality of the silage at the highest temperature was much inferior to the others, as the content of butyric acid and ammonia was larger. By a rise of temperature from 14 to 29°C. the loss of dry matter increased from

10.0 to 13.8 per cent with the addition of molasses and from 4.5 to 8.5 per cent with the addition of AIV solution.

The influence of the dry matter content in the material was investigated in three experiments where fresh and more or less dried crops were used. With the increase of dry matter content, the amount of effluent decreased. Moreover, the quality of the silage improved as the content of acetic acid, butyric acid and ammonia decreased and the content of lactic acid increased. Further, the loss of nutrients was reduced and the amount of dry matter present in a certain silo volume increased. The losses by drying were comparatively small when the crop was dried only 24 hours. Also when the results of the different experiments were compared a marked influence of the dry matter content in material could be proved. With an increase from 13 to 35 per cent, the loss of dry matter decreased from 9.8 to 2.4 per cent with addition of AIV solution, and from 15.5 to 4.7 per cent with the addition of molasses.

HERBAGE REVIEWS. **Five years of AIV fodder.** *Herb. Rev.* 3. 83. 1935. **385**

HILDEBRANDT. Toro-Silon ein wirksames Grünfutterkonservierungsmittel? [**Toro-silon, an efficient means of green fodder conservation**?] *Mitt. dtsch. LandwGes.* 48. 731-2. 1933. **386**

"Toro-Silon," a commercial preparation claimed to facilitate successful ensilage, has been tested at seven research stations in trench and in tower silos, for green fodder containing much protein and for fodder containing more carbohydrates, and in no case has it been found to promote lactic acid fermentation or sterilization.

HONCAMP, F., MEIER, O., NEUMANN, K., SCHRAMM, W., and WÖHLBIER, W. [**Losses of crude and digestible nutrients in sugar beet leaf silage made in the usual way and with addition of different preservatives, Alfasil, Defu solution and Penthesta.**] *Züchtungskunde.* 9. 214-21. 1934. **387**

In these experiments the loss of nutrients was not significantly less than in silage carefully made by cold fermentation, but might be further reduced. The silage fed to wethers was as readily eaten and gave fully as good results as silage without preservative. [N. A. and R.]

HOSIER, A. **Stack silage.** *J. Minist. Agric.* 47. 220-4. 1941. [Marlborough] **388**

The advantages of stack silage are discussed. The importance of using young succulent herbage is stressed. A stack 6 yards in diameter can be made from 20 acres of "ton per acre" hay crop. The sides of the stack should be kept absolutely vertical. If the

herbage to be ensiled is older the possibility of watering may have to be considered. Crops suitable for silage making and the methods of gathering are discussed. To obtain the best results the crop should be cut as early as possible, should be carted as quickly as possible and should be trampled as hard as possible. [N. A. and R.]

ISAACHSEN, H., ULVESLI, O., and HUSBY, M. Undersøkelser over surfôr og AIV fôr. [**Investigations on silage and AIV fodder conservation.**] *Meld. Norg. LandbrHøisk.* 16. 309-60. [English summary, 358-9.] 1936. **389**

Data are given for dry matter, protein, N.-free extractives, amides, fat, fibre and total ash in grass silage made without addition, and with addition of a solution of NaCl, Na_2HPO_4 and $CaCl_2$ or of sour whey and by the Virtanen process, and for potato silage made by the usual method and by Virtanen's process. Digestibility coefficients are given for the grass silages.

Ordinary potato silage showed a dry matter loss of 15 per cent, but made by Virtanen's method the loss was only 3 per cent. The AIV potato silage was readily taken by pigs in quantities up to 4.5 kg. per head, which is equivalent to about 20 kg. turnips. [N. A. and R.]

JACOBSON, G. Beredning av AIV-fodder. [**Preparation of AIV fodder.**] *Sverig. Utsädesfören. Tidskr.* 54. 269-70. 1944. **390**

Herbage from the first and second cut of legume-rich first-year leys is very suitable for AIV fodder. Lucerne does not give the best results because it is frequently too coarse and the amount of acid used is insufficient. The silos should be large enough to contain 6 weeks' supply of fodder. Losses during packing should not exceed 10 per cent ; AIV fodder, unlike hay, can be stored for many years without further losses. In contrast to artificially dried material, the carotene content is retained in AIV fodder, and by its use " summer milk " is produced all the year round.

JANSE, L. C. Een opmerking bŷ het analyseeren van versch gras in kuil. [**The analysis of fresh and ensiled grass.**] *Landbouwk. Tijdschr.* 53. 631-2. 1941. [Lab. Fed. Co-op. Dairy Factories, Friesland] **391**

From the data obtained it is concluded that the temperature at which hay, ensiled grass and fresh grass are dried for analysis is of great importance. Drying at low temperature and *in vacuo* is advised. [N. A. and R.]

JARL, F. Resultat från Husdjursförsöksanstaltens senaste försök med foderkonservering. [**Results of the most recent experiments in fodder conservation at the Animal Husbandry Research Institute.**] *Sverig. Utsädesfören. Tidskr.* 53. 331-5. 1943. **392**

In the autumn of 1942 the experimental farm of the Institute was provided with equipment for ensiling experiments comprising six 2.5 m. cement silos. In these was placed rather coarse aftermath clover from first year leys. The green fodder was slightly too advanced in growth and also wet with rain when placed in the silos. Ensiling was carried out: (1) according to the AIV method; (2) with the addition of dilute formic acid; (3) with the addition of formic acid and phosphoric acid; (4) according to the Miko method; (5) according to the Miko method without Miko salt; and also (6) according to the cold fermentation process.

The experiment showed that the greatest losses by expressed juice occurred with the AIV and Miko methods, while the lowest fermentation losses of organic matter in the green fodder were obtained by the AIV method. The total loss of organic matter amounted for the AIV method to 9 per cent, while the other percentages of loss were: addition of formic acid 16 per cent, addition of formic acid and phosphoric acid 16 per cent, the Miko method 18 per cent with and 19 per cent without Miko salt, and in the cold fermentation silage 19 per cent.

Two feeding trials were carried out, one at the Institute's experimental farm and the other at Rossared near Kungsbacka; they showed that AIV fodder and formic acid fodder were of equal value, while the cold fermentation silage gave a poorer yield. (See also Bull. 33 of Pasture Bureau for a longer version of this article.)

JOHNSON, B. C., PETERSON, W. H., HEGSTED, D. M., and BOHSTEDT, G. **A study of various methods of preserving legumes and other forages by ensiling.** *J. agric. Res.* 62. 337-48. 1941. [Wisc. Agric. Expt. Sta.] **393**

Over a hundred lots of silage put up in many different ways over a period of several years have been compared as to appearance, odour, preservation, pH value, and carotene content. Methods considered for the preservation of legume silages included, besides the standard AIV., molasses, and phosphoric acid methods, the use of such preservatives as soured-whey concentrates, corn meal, sulfamic acid, soured molasses, sodium chloride and phosphorus pentasulfide. Of the latter, whey powder, soured-whey concentrate and corn meal gave the best results.

JOHNSON, B. C., PETERSON, W. H., KING, W. A., and BOHSTEDT, G. **Alfalfa silage preservation. Comparison of phosphoric acid and molasses as preservatives.** *Industr. Engng Chem.* (*Industr. Ed.*) 32. 1622-5. 1940. **394**

Carotene losses varied from 3 to 15 per cent for alfalfa silage made by the use of 65 lb. of molasses per ton, from 3 to 9 per cent for the silage preserved with 20 lb. or more of phosphoric acid and

from 24 to 44 per cent for silages made with less than 20 lb. of phosphoric acid per ton. The carotene content of the silages was reflected in the vitamin A potency of the milk produced from them. Average figures for milk produced during two winter periods (November to February) expressed in μg. per g. of butterfat, were: for molasses silage, carotene 9.8, vitamin A 8.0; for silage made with 20 to 30 lb. of phosphoric acid per ton, carotene 7.3, vitamin A 7.5. Blood analyses confirm these results. The molasses silage and that made with 20 to 30 lb. of phosphoric acid were equally satisfactory as to palatability, effect on milk production, maintenance of weight of the animals and absence of " off-flavour " milk. [D. S. A.]

JOURNAL OF DAIRY SCIENCE. **Studies regarding the use of mineral acids for the preservation of forage.** *J. Dairy Sci.* 18. 439-40. 1935. **395**

Second crop green forage, mostly alfalfa and clover, was chopped and ensiled in wooden tower silos. A 1 : 4 mixture of 2N sulphuric and hydrochloric acids was added, the resulting pH of the silage being 4.31 instead of 4.00 as intended. The losses were similar to those of maize silage handled in the same way. A similar lot of forage was made into hay and chopped.

In feeding trials with cows, the acid silage was used as the only roughage for one group, and the hay for another. For two other groups the roughage consisted of 2 lb. maize silage per cwt. live weight plus acid silage and ordinary long alfalfa hay alternately in periods of 6 weeks. There was little difference in production between the acid silage and hay-fed groups. The vitamin A and carotene values per unit of fat were similar at the same stage of the experiment. The carotene content of the butter fat declined from 7.5 to 3.5 mg. per kg. during the first two months and thereafter remained nearly constant. [N. A. and R.]

JOURNAL OF THE DEPARTMENT OF AGRICULTURE, DUBLIN. **Conserving hay by the "Solages" method.** *J. Dep. Agric., Dublin.* 31. 297-8. 1932. **396**

JOURNAL OF THE DEPARTMENT OF AGRICULTURE, IRISH FREE STATE. **The "silo acid" method of making silage.** *J. Dep. Agric. Ire.* 31. 88-9. 1932. **397**

A description of Prof. von. Kapff's method, grass, clover, vetch, etc. being converted into silage by the cold fermentation process with the use of von Kapff's "silo acid."

KING, W. A. **Comparison of limestone and sodium bicarbonate as neutralizers for phosphoric acid oat silage.** *J. Dairy Sci.* 26. 975-81. 1943. [N. Jersey A.E.S., N. Brunswick] **398**

From acid base measurements of the blood and urine of cows receiving acid oat silage, it was shown that, while sufficient limestone to neutralize the 3 H atoms of the phosphoric acid was required to prevent or to eliminate acidosis, the same result could be achieved with $NaHCO_3$ sufficient only for 2 atoms of H. Similarly, improvements effected by $CaCO_3$ sufficient for 2 atoms of H were equalled by $NaHCO_3$ sufficient for 1 atom. A mixture of limestone and bicarbonate in the ratio of chemical equivalents which would neutralize 2 atoms of H also proved adequate in removing all symptoms of acidosis. When the silage was fed with grain containing 2 per cent of added limestone and with hay, the improvement brought about was very small. Consumption and milk production both increased when the silage was satisfactorily neutralized. [N. A. and R.]

KING, W. A., and BENDER, C. B. **The nutritive value of corn meal preserved silages.** *J. Anim. Sci.* 2. 361-2. 1943. [A.E.S., N. Jersey] **399**

Alfalfa ensiled with 480 lb. of maize meal per ton of green material, and soybeans ensiled with 250 lb. of maize meal per ton, were fed, with hay *ad libitum*, to two groups of 5 cows each, at the rate of 50 lb. daily. Milk production dropped rapidly from an average of 40 lb. daily to 30 lb. and less. The cows receiving the alfalfa silage lost no weight but those receiving the soybean silage lost an average of 58 lb.

Two of the cows receiving alfalfa silage were able to consume exceptionally large quantities and maintained both their milk production and their live weight. The limiting factor of this diet is the roughage capacity of the animals. To feed good milk producers with an average appetite all their concentrates through silage, it would be necessary to add more than 500 lb. of maize meal to each ton of green material. [D. S. A.]

KIRSCH, W. Bemerkungen zur Verwendung von Chemikalien bei der Silofutterbereitung. [**Observations on the use of chemicals in ensilage.**] *Mitt. dtsch. LandwGes.* 48. 510-1. 1933. [Tierzucht Inst., Univ. Königsberg] **400**

Caution is recommended with regard to the use of chemicals in ensilage. The actual process is not dependent upon them, and they are at the best a safeguard. In some cases chopping alone and in others chopping, together with the use of sugar, renders them superfluous. Farmers are advised of sources whence expert advice may be obtained.

KIRSCH, W., and HILDEBRANDT, H. Vereinfachung und Verbilligung der Gärfutterbereitung durch Ansäuerung des Grünfutters.

[**Ensilage simplified and cheapened by the acidification of green fodder.**] *Dtsch. Landw. Pr.* 59. 135-6 and 148. 1932. **401**

——————— Arbeitsvorschriften für die Kaltvergärung mit Ansäuerung des Grünfutters. [**Directions for cold fermentation with acidification of the green fodder.**] *Ibid.* 59. 186. 1932.

The so-called cold fermentation process, when employed with meticulous care, offers a sure means of producing good fodder, but has the disadvantage of requiring a comparatively large outlay upon massive silos and chopping machines, a circumstance which has always been an obstacle in the way of the general adoption of the practice. As the conservation of fodder in simple containers without previous chopping had become a generally established practice in Finland, the authors undertook a journey to this country with a view to gaining on the spot an insight into the process introduced by Professor Virtanen. They were able certainly to convince themselves of the good results of the process, but a closer insight into the methods adopted and the composition of the acid employed was not permitted them, because the process is being patented and a considerable sum is demanded for divulging it to Germany. The authors therefore reverted to the experiments with hydrochloric acid already begun by Professor Fingerling in 1923, and themselves carried out numerous experiments of ensilage by the addition of hydrochloric acid mixed with lactic acid, phosphoric acid, and phosphate salts amongst others. The final result was a practical process which considerably simplifies ensilage by the addition of acid. Instructions for the carrying out of this process are embodied in the " Directions."

Kleinert, H. Milchsäure als Sicherungszustaz bei der Gärfutterbereitung. Ein Vergleich zwischen normaler Kaltvergärung und der Vergärung bei Zusatz von Milchsäure, Salzsäure, Schwefelsäure, Zucker. [**Lactic acid as a preservative in the making of silage. Ordinary ensiling compared with ensiling with addition of lactic acid, hydrochloric acid, sulphuric acid or sugar.**] *Biederm. Zbl. B. Tierernähr.* 10. 122-86. 1938. [Inst. Tierzucht Milchwirtsch., Univ. Leipzig] **402**

Good silage was obtained from red clover and lucerne with each of the above additions. Equivalent quantities of the acids gave approximately the same efficiency of conservation. The results were markedly improved by chaffing the material finely. If the ratio crude protein : N-free extractives is narrower than 1 : 2 the optimum rate of addition is 0.4 per cent HCl, 0.6 per cent H_2SO_4, 1 per cent lactic acid or 1 per cent sugar. If the ratio is wider than 1 : 2 the proportions should be reduced to 0.2 per cent HCl, 0.3 per cent H_2SO_4, 0.5 per cent lactic acid or 0.5 per cent sugar. [N. A. and R.]

KNOTT, J. C., HODGSON, R. E. ,and GRAVES, R. R. **The stack silage method of preserving forage crops and the comparative nutritive value of oat and pea silage made in a stack and in a tower.** *J. Dairy Sci.* 18. 438. 1935. [Washington State Coll.] **403**

For both stack and tower method the crop was chopped and the silage in each case was palatable to both cows and sheep. The stack silage contained 20 per cent more moisture than the tower silage, while the chemical composition of the dry matter was similar.

In tests with sheep it was found that the digestibility of the crude protein in the stack silage was 17 per cent less than that of the tower silage, while the digestibilities of the ether extract and of the N-free extract were about the same. [N. A. and R.]

KÖNIG. Gärfutterbereitung für die Schweinefütterung. [**Preparation of silage for pig feeding.**] *Z. Schweinez.* 44. 577-8. 1937. **404**

The preparation of silage for feeding to pigs from root crops such as potatoes and sugar beet, and from green feeds, such as lucerne and sweet lupins, is discussed.

It is desirable to have a lactic acid fermentation because lactic acid has a pleasant smell and a high nutritive value. To achieve this, and to avoid the production of acetic and butyric acids, it is essential, when ensiling potatoes, to keep out as much air as possible by treading down the potatoes closely, and providing an air-tight cover.

In preparing silage from green feeds, if acid is not added, it is essential, in order to ensure a suitable medium for the growth of lactic acid bacteria, to add 1 per cent sugar or 2 per cent molasses. Sugar beet tops, however, are rich in carbohydrate so that fermentation proceeds easily without the addition of sugar. Beet tops can be ensiled in unlined earth trenches. [N. A. and R.]

KRAUSS, W. E. **Preservation of grass silage by new methods.** *Cert. Milk.* 16. 5 and 20-2. 1941. **405**

Preservatives used hitherto at the Ohio Experiment Station are molasses which increase the carbohydrate content particularly of legume silages and so increase desirable fermentation, and phosphoric and mineral acids which preserve the carotene content. To avoid expense, preservatives available on the farm could be used, such as whey (lactic acid) if in a cheese making district. Alternatively, dry matter could be increased. Good silage could be made without preservative and without undue loss of juice if the dry matter were between 25 and 40 per cent. Dry matter may be introduced as dry hay or as corn and cob meal.

KRISTENSEN, R. K., and TIND-CHRISTENSEN, C. J. Ensileringsforsøg med Sødlupin, Kløvergræs og Roetop. [**Ensilage experiments with sweet lupin, clover-grass and beet tops.**] *Tidsskr. Planteavl.* 49. 664-717. 1945. **406**

Sweet lupin and beet tops constituted the main material, but a few tests were also carried out with clover-grass and lucerne. The experiments were conducted at the experiment stations in Lyngby, Tylstrup, Studsgaard, Ribe, Højer and Jyndevad, where a series of experimental silos have been installed of such a size that ensiling can take place under conditions approximating those prevailing in practical agriculture.

A comparison was made between the addition of AIV acid and molasses : the addition of Amasil was tested, also the addition of molasses with and without the draining off of liquid. Of lupins both fresh and weathered material was ensiled, and lupins and beet tops were ensiled both without and with chopping of the material.

The addition of AIV acid effected a more rapid and more pronounced settling of the material and a much lower temperature in the silos in the early period. The method is the most reliable, has given the smallest loss of dry matter and protein, particularly of pure protein, and the best quality of silage, but the quantity of acid applied should be sufficient for the reaction number to be below 4. Amasil is a valuable substitute, but gives a larger loss of protein and a silage of slightly poorer quality. In preliminary experiments a cutting up of beet tops without any addition has shown results corresponding to those with the Amasil treatment.

The addition of molasses has no appreciable influence on the temperature, the settling or reaction number compared with no addition. In molasses some dry matter with feeding value is supplied and if this is included and considered in the computatin of loss, the losses of dry matter are as great as without addition. If the dry matter of molasses is omitted from the calculation, the loss of dry matter is about the same as with the AIV method, but the loss of pure protein is substantially greater and the quality of the silage poorer.

In connexion with the addition of molasses, ensiling of weathered lupin showed a greater loss than that of fresh material where the weathered material had not been cut into chaff. With weathering allowance must be made for loss in the field.

LEPARD, O. L., and SAVAGE, E. S. **The losses resulting from the ensiling of legumes and grasses with varying amounts of phosphoric acid.** [Abstract of paper to 35th Ann. Meeting Amer. Dairy Sci. Assoc.] *J. Dairy Sci.* 23. 561-2. 1940. [Cornell Univ.] **407**

The crops studied were mixed grass, clover and alfalfa ; timothy and other grasses ; and medium well-matured soybeans.

LEROY, A. M., and ZELTER, S. Z. Étude concernant la façon d'ensiler les pulpes de betteraves sucrières. [**Methods of ensiling sugar beet pulp.**] *Ann. agron., Paris* 18. 78-101. 1948. [Inst. Nat. Agron.] **408**

The subject is discussed under the following headings: the theory underlying the process of ensilage; methods of ensilage; the chemical analyses for estimation of acids and pH; and the record of experiments and results, for which much tabulated material has been collected. The conclusions stress the need for drainage, packing of the material, and adding formic acid to bring the pH to a value of 3.8; this is in order to reduce butyric acid, increase lactic and acetic acids and to reduce the loss of hydrocarbons which develop during the course of conservation. Addition of formic acid preserves the colour and smell of the fresh pulp and is therefore more acceptable to the animals.

LING, A. W., and PEEL, W. R. **Grass silage and silos.** Soc. Chem. Indust., Chem. Eng. Group. Harrison, London, 1935. pp. 12. **409**

Processes at present in use in Great Britain for the preparation of grass silage are described, namely, untreated process, treated with molasses, AIV process, and miscellaneous processes.

A short description, accompanied by photographs and diagrams, is given of various types of silo, including the polygonal wooden silo, concrete block silo, iron tower silo and portable wooden silo.

The following statistical data mentioned in the paper are of interest. It is estimated that cows and heifers in the U.K. over one year old eat grass or hay to the value of £120,000,000 annually. This is equivalent to the food material obtained from 15,000,000 tons of Egyptian cotton cake and 5,000,000 tons of oats. [N. A. and R.]

MIHIN, A. M. [**The role of moisture in the preparation of silages.**] [Contained in: Feeding of farm animals and fodder production.] Moscow, 1940. 233-42. [State Research Institute of Fodders.] **410**

A series of experiments, have been carried out in the drought-susceptible region of the U.S.S.R. to ascertain the following facts: (1) the effect of the initial moisture content of the plant mass on the biochemical processes occurring during its conversion into silage; (2) the role of CO_2 as a preserving factor; (3) the causes of repression of micro-biological and biochemical processes on ensiling plants with a low moisture content; and (4) commercial production of silages from plants with a low moisture content, and the appraisal of their fodder value. Silages were prepared from vetch + oats mixture, clover, vetch alone, nettles, lucerne, meadow herbage, meadow

herbage + water, potato haulms, potato haulms + 2 per cent sugar + water; their moisture content varied from 48.64 to 96.00 per cent. The pH of the silage varied from 3.75 to 6.20 and was in inverse proportion to the original percentage of moisture in the plants.

MINNESOTA Agricultural Experiment Station. Bull. 360. **Hay crop silage.** By *N. N. Allen* and *J. B. Fitch*. 1942. pp. 16. **411**

Silage made from crops ordinarily harvested and cured as dry hay, though generally referred to as "grass silage" is better termed "hay crop silage" as legumes are more commonly used than the true grasses. This method of ensiling is more generally practised in the New England States and in the Pacific Northwest, but little has so far been done in Minnesota. The national programme of soil conservation by encouraging the growing of more legumes and less corn has, however, recently caused a revival of interest in this method.

Experimental work on silage conducted at the above Station has shown that the feeding value of the silage depends upon that of the fresh material and the stage at which it is harvested. Silage made from legumes or young grass contains more protein than corn silage. Under certain conditions crops such as sweet clover may be used and reed canary grass also makes palatable silage. The quality may be improved by the addition of preservatives such as molasses, acid or ground corn, but even so it is important to regulate the moisture content of the green material and the reduction of moisture by wilting helps to prevent loss of nutrients by seepage of juice.

Directions as to time of cutting and methods of ensilage are given.

MISSOURI Agricultural Experiment Station. Circ. 234. **Grass silage in wartime.** By *H. A. Herman* and *A. C. Ragsdale*. 1942. pp. 4. **412**

The chief advantages of silage are independence of weather during preparation; conservation of nutrient material, particularly vitamin A; reduction in storage space and therefore storage costs; and the fact that silage made from grasses, legumes and cereals fits into a soil conservation programme.

The methods are outlined for the preparation of silage without the use of molasses or mineral acids as preservatives. (1) Corn or other cereal grains are added, the sugars of which break down to form preservative acids similar to those of molasses. (2) The crop is allowed to wilt until its moisture content is reduced to 65 per cent. A device is described which overcomes the difficulty of determining the moisture content or dry matter content of the crop. (3) Dry

or green sugary crops such as dry sorgho fodder or dry corn fodder are added to the legumes to be ensiled. Instructions for feeding silage are given.

MONROE, C. F., and HAYDEN, C. C. **Studies of AIV silage. Preparation and feeding.** *J. Dairy Sci.* 19. 453. 1936. **413**

MONROE, C. F., HAYDEN, C. C., PERKINS, A. E., KRAUSS, W. E., KNOOP, C. E., and WASHBURN, R. G. **Phosphoric-acid treatment for meadow-crop silages.** *Bi-m. Bull. Ohio agric. Exp. Sta.* Vol. 30. No. 234. pp. 96-102. 1945. **414**

Phosphoric acid has the advantage over other acids, such as hydrochloric and sulphuric, in supplying a nutrient element to the silage. The quality of phosphoric acid-treated silage has been studied. The phosphoric acid was not effective in preserving the carotene. In a feeding trial cows gained less weight and produced less milk on phosphoric acid-treated silage than on maize silage. The use of phosphoric acid as a preservative in meadow crop silage is not recommended.

MOORE, H. I. **Hay and silage making.** [Contained in] England and Wales, Min. Agric. and Fisheries, N.A.A.S. Yorkshire and Lancashire Province. Report of Conference, Leeds, October 1947. pp. 11-16. [Mimeographed] **415**

Paper read at the above conference, to discuss the general topic "The Utilization of Grass." To obtain maximum yield of nutrients per acre as against maximum yield per acre, hay crops should in general be cut 10-14 days before they normally are. Tripoding and cocking or piking are suggested as the best methods of haymaking. Whatever method is employed, the losses of nutrients in hay-making will usually be of the order of 0.25 to 0.33 of the original value of the crop.

The use of molasses and AIV acid for silage making, equipment for handling green crops and types of silos are discussed. For waste-free silage production, an airtight container from which rainwater is excluded is necessary. Each acre of grassland laid aside for the provision of winter keep should produce 30 cwt. high quality hay and 4 tons of high-protein silage.

MOORE, H. I., and WILLCOX, J. S. **Silage quality. An analysis of ten years' results: 1937- 1946.** *J. Minist. Agric.* 54. 101-5. 1947. [Univ. Leeds] **416**

To ensure a waste-free silage of high feeding value, the following points should be noted. (1) The crop must be cut at a young, leafy stage of growth. (2) The silo must be airtight, and it must be adequately protected from rain. (3) Provision for the escape of

effluent must be made. (4) The material should be filled evenly, uniformly trodden, and each 3-foot layer allowed to reach an optimum temperature of 90°F. before more is added. (5) With kale ensiled in a clamp, treading is unnecessary. (6) With the exception of kale, crops cut at an immature stage should have 15-25 lb. of molasses added per ton of crop.

MORLES, D. W., BOTHAM, G. H., and THOMPSON, W. B. **A comparison of the changes involved in the ordinary molasses and AIV processes.** *J. agric. Sci.* 27. 151-61. 1937. **417**

NEBELSIEK, H. Der Einfluss neuerer Sicherungszusätze bei der Einsäuerung grüner Futterpflanzen auf die Zusammensetzung und den Nährwert des gewonnenen Gärfutters. [**The effect of new ensilage solutions upon the composition and nutritive value of the silage.**] *Biederm. Zbl. B. Tierernährung.* 8. 161-85. [English summary, 185.] 1936. [Landw. Versuchssta. Rostock, Germany] **418**

Two commercial products for ensuring successful ensilage of red clover were compared with sugar, with satisfactory results.

NIKENDEY, A. Ergebnisse der Konservierung von Grünfutter nach dem AIV Verfahren. [**Conservation of green forage according to the AIV method.**] *Landw. Fachpr. Tschechosl.* 15. 187. 1937. **419**

Results of two experiments with stubble clover are reported. Frozen clover harvested under the worst conditions of snow was made into first class ensilage containing no butyric acid and only traces of free acetic acid. Data of analyses made by the State Institute for Biotechnology, Praha, are given.

NITSCHE, H., and WITTIG, H. Gewinnung von organisch-saurem Futter ohne Einkammerung in Gärbehältern? [**Preparing acid silage without the use of silos.**] *Biederm. Zbl. B. Tierernähr.* 9. 135-46. 1937. **420**

A mixture of dried beet slices, chopped straw and skim milk or buttermilk when left to stand underwent marked fermentation with rise in temperature to about 40°C. The resulting material had a total acid content of 1.5—1.7 per cent. There was a marked drop in the percentage of fat and true protein and in the digestibilities of both total and true protein. The process does not appear to have any practical application. [N. A. and R.]

OHIO Agricultural Experiment Station. Bull. 656. **Hay-crop silage. A summary of ten years' work.** By *C. C. Hayden, A. E. Perkins, C. F. Monroe, W. E. Krauss, R. G. Washburn* and *C. E. Knoop.* 1945. pp. 25. **421**

This bulletin gives a summary of results of experiments in making and feeding silage carried out at the Ohio Experiment Station during the ten-year period 1932 to 1942. Most of the results concern silages made from lucerne or lucerne and clover and grass mixtures. The trials included the use of sulphuric and hydrochloric acid (AIV process), phosphoric acid [MONROE *et al.*], molasses, ground maize and solid carbon dioxide as preserving agents. While all of these additions would on occasions bring about an improvement in the quality of the silage the beneficial effect was often very small and from a study of 69 silages made with and without preserving agents the authors conclude that the dry matter content of the material to be ensiled may be a more important factor in influencing silage quality than the preservation treatment used. [D. S. A.]

OLESEN, N. A. [**Experiments on making hay and silage. 1. Experiments on curing hay and ensiling.**]

ESKEDAL, H. W., and ØSTERGAARD, P. S. [**2. Experiments on the feeding value of hay and silage.**]

ROTTENSTEN, K. [**3. Experiments on adding basic supplements to AIV silage fed to steers.**] 172*nd. Rep. Res. Lab. Roy. Vet. Agric. Coll. Copenhagen.* 1937. pp. 140. **422**

The results of 15 experiments in hay and silage making (clover grass mixture cut at early flowering) during the years 1931 to 1936 are described. Hay dried on racks contained 1.2—1.4 per cent more dry matter when stored than did hay from cocks. Loss of dry matter from hay was slightly greater than from AIV silage (13.9 and 11 per cent) and the same held for crude protein (22.5 and 18.7 per cent). But on the other hand about 5.5 per cent (on dry matter of the silage had to be discarded because of spoilage at the surface and sides of the silo. Considerable hydrolysis of protein to amides occurred. Losses from sugar silage were considerably greater than from AIV silage and breakdown of protein to ammonia occurred. One sample out of five was completely spoiled.

Feeding experiments in which hays harvested by different methods were compared in groups of 33 cows showed no significant difference in feeding value. Hay was compared with AIV silage in tests with 105 cows on each. There was a small difference in favour of silage and 5.93 kg. dry matter as silage were at least equivalent to 6.76 kg. dry matter as hay. AIV and sugar silage were compared in experiments with 35 cows on each. AIV silage was superior. Tests with small and large rations of hay showed that 6.38 kg. dry matter as hay could replace 2.06 kg. concentrates, 1.9 kg. roots and 4.5 kg. straw, i.e., 100 kg. dry matter as hay had a starch equivalent of 37.

An experiment on 8 steers is also described in which the effect of adding bases to AIV silage, sufficient to neutralize half the acid originally added, was studied. Silage provided two-fifths of the total feed units. Two served as controls on a ration of grass, roots and hay ; 2 were given $NaHCO_3$, 2 $CaCO_3$ and 2 silage without addition of base. In the last there was a definite fall in alkali reserve and rise in urinary ammonia which were partly counteracted by the chalk and more completely by the sodium carbonate. There was no significant difference in composition of the blood or bones, or in pH of different parts of the intestinal tract. [N. A. and R.]

Olsen, F. Forsøg med opbevaring af mask. [**Experiments on the ensiling of draff.**] *Beretn. Forsøgslab. København.* No. 199. 1942. pp. 85. **423**

1. The chemical composition of lucerne, cocksfoot and, to a less extent, ryegrass varied with increasing maturity ; the protein content fell while the crude fibre content increased. With these changes in chemical composition pasture plants became less digestible and this applied to all nutritive constituents. The calculated nutritive value in feed units and the protein content fell with increasing maturity.

Experiments with wheat straw showed that steam treatment did not improve the digestibility.

Brewer's draff was investigated fresh, dried and ensiled according to the AIV method. Neither drying nor ensiling diminished the digestibility or feeding value of draff.

2. Calculations were made of the least value of the difference between digestibility coefficients which might be regarded as statistically significant.

3. Ensiling according to the AIV method was the most efficient and least expensive method of preserving draff. [N. A. and R.]

Orla-Jensen, S., Orla-Jensen, Anna D., and Kjaer, A. **On the ensiling of lucerne by means of lactic acid fermentation.** *J. Microbiol. Serol.* 12. 97-114. 1947. [Inst. Teknisk Kemi, Copenhagen] **424**

Lucerne is particularly difficult to preserve in view of its high protein content, and hence its strong buffer effect. Whey and beet sugar molasses were used as the substrate for streptobacteria.

Pennsylvania Agricultural Experiment Station. Fifty-ninth annual report. July 1946. State College, Pa. pp. 66. **425**

Silage. In silage tests, liquid Curbay (condensed molasses distiller's solubles) was not a desirable preservative for ladino clover/orchard grass silage. In preparing alfalfa silage an adequate supply of fermentable sugar has been found to be the most important single factor in silage preparation.

PERKINS, A. E. **New methods for preserving legume forage.** *Bi-m. Bull. Ohio agric. Exp. Sta.* No. 177. 200-5. 1935. **426**

PETER, H. Chemische und bakteriologische Untersuchungen über die Wirkung der künstlichen Ansäuerung mit Salz-und Schwefelsäure auf die Konservierungsvorgänge bei grünem Klee. [**Chemical and bacteriological studies of the effect of addition of hydrochloric and sulphuric acids on the conservation of green clover.**] *Z. Zücht. B.* 34. 85-103. 1936. **427**

Small scale experiments were carried out in glass cylinders holding 2 kg. green fodder mixed with the appropriate acid. Successive cylinders were opened and the contents examined at intervals from 12 hours up to 60 days after filling. The green fodder used was red clover, second cut in August, and clover stubble cut in September. The acids were generally added at the rate of 10 equivalents per 100 kg. fodder, but in some cases higher concentrations were used. On the ensiled material determinations of pH, free and combined lactic, acetic and butyric acids, crude and true protein, in addition to bacteriological examinations, were made. The acid preserved material showed lower pH than the controls and the amounts of combined organic acids were lower and the protein breakdown less. There was no difference between the effects of the two acids used. [N. A. and R.]

PETERSON, W. H., HART, E. B., ELVEHJEM, C. A., BOHSTEDT, G., and RUPEL, I. W. **Compare merits of AIV and molasses silage.** Wisconsin Agric. Exp. Sta. 53rd Annual Report. Bull. 438. 1937. pp. 51-2. **428**

PHILLIPS, R., DAVIES, R. O., and ASHTON, W. M. **Salt in hay and silage.** *J. Minist. Agric.* 52. 98-9. 1945. [Univ. Coll. Wales, Aberystwyth] **429**

Addition of salt to hay stacked in an imperfectly dried condition can reduce both mould development and loss of organic matter, and losses of organic matter occurring in the stack are subject to considerable variation. Salt is as effective as molasses in promoting fermentation in grass and clover silage.

PICCHI, A. L'insilamento dei foraggi con il metodo cremasco. [**Ensiling fodder by the Crema method.**] *Riv. Zootec.* 12. 379-88. 1935. **430**

By ensiling half dried fodder in silos of the Crema type, a greater amount of fodder of higher nutritive value is obtained than by converting the same initial amount of green food into hay. Since the feeding of these fermented fodders to cows might possibly have an unfavourable influence on the bacteriological quality of the milk,

samples of the silage hays were examined to determine the dominant flora. The number of sporting, gas forming bacteria increased with increasing humidity of the sample and with diminished pressure. 36 per cent of the samples examined were of the "lactic" type of fodder, regarded as the best by Gorini and others. To increase this percentage it is recommended that the moisture content of the fodder at the time of ensilage should be about 40 per cent and that the pressure in the silo should be 6-8 quintals per sq. m. [N. A. and R.]

PIRAUX, E. **Ensilage trials with addition of acid.** *Bull. Inst. agron. Gembloux* 3. 239-46. 1934. **431**

PLATZMANN, M. Nochmals "Die Bedeutung des einwandfreien Gärfutters." [**The importance of good silage.**] *Dtsch. landw. Tierz.* 46. 331-4. 1942. [Rittergut Holmstädt, Saale] **432**

A method of layering silage enables green crops, rich in protein, to be stored together with root crops rich in sugar. A formula which has given very good results and in which poorest quality potatoes can be used consists of successive layers of 1600 to 200 kg. steamed potatoes, 800 to 1000 kg. green fodder mixture (lucerne or clover, with chopped sugar beet leaves and tops if desired) and 2000 to 2500 kg. washed, untopped turnips, with a final layer of steamed potatoes. The mass is interspersed and enclosed top and bottom with layers of chaff and rape husks to the extent of 800 to 1000 kg., to absorb the juices from the main body of the silage. Analysis showed 20 to 21 per cent dry weight, 15 to 16 per cent total nutrients and 1.5 to 1.6 per cent protein. [N. A. and R.]

POIJÄRVI, I. Resultat från försök med AIV-foder. [**Results from experiments with AIV fodder.**] *Nord. JordbrForskn.* 1935. No. 4-7. *Beret. Nord. JordbrForsk.* 5. *Kong.* pp. 734-43. **433**

The author gives results obtained in experiments with the AIV method of fodder conservation conducted in the Animal Husbandry Department of the Finnish Institute of Agricultural Research during the years 1929-1934. Data given in tabular form record details of food units, digestible crude and pure protein according to botanical composition of the material.

POIJÄRVI, I. Orientierende Versuche mit einer neuen Ensilierungsmethode. [**Preliminary trials with a new method of ensilage.**] *Maataloust. Aikakausk.* 15. 25-35. [Finnish summary, 35] 1943. [Received 1946] [Agric. Exp. Sta., Tikkurila, Finland] **434**

The silage was prepared using 0.6 per cent of the grass weight of slaked lime and 1.0 per cent common salt. The present article is not concerned with the theory of the method, but only with the

quality of the silage. There was but very slight loss of material. Proteins broke down rapidly but only as far as the amino acid stage. The fodder was highly digestible, more so than silage made of the same grasses by the A.I.V. process. The chlorine content was not high enough to be injurious. The silage had a good aroma, was acceptable to the animals, and was free from mould.

PRECHT, H. Eingesäuerte Kartoffeln und Zuckerrüben in der Schweinemast. [**Potato and sugar beet silage in pig fattening.**] *Z. Schweinez.* 42. 771-3. 1935. **435**

In the preparation of sugar beet silage the loss of sugar is usually high. To prevent this it is suggested that the sugar beet should be ensiled without slicing and that the whole beet should be surrounded with potato pulp (1 part beet to 4 parts potatoes) before steaming and pitting. [N. A. and R.]

ŘECHKA, J. Výsledky konservace vojtěšky nakládané různým způsobem. [**Results of lucerne conservation by different methods.**] *Zeměd. pokrok.* 3. 192-3. 1936. [Inst. Anim. Biotechnology, Prague] **436**

Lucerne harvested before blossoming was cut into pieces 4-5 cm. long, packed into silo pits and at the same time sprayed with a solution of silo-acid. After 7 months the silage was analyzed. Uncut lucerne without acid (control) showed the greatest losses of dry matter and protein and contained the highest percentage of butyric acid. The best results were obtained when the silo-acid was diluted with water in certain proportions. The ensilage had no noxious influence on dairy cows during feeding trials extending over a month.

REHM, E. Die Einsäuerung eiweissreichen Grünfutters unter besonderer Berücksichtigung der Kaltvergärung mit luftdichtem Deckelverschluss und die Bewertung des Gärfutters durch den Tierversuch. [**The ensilage of green fodder rich in proteins, with special reference to the cold fermentation process, using airtight covers, and the testing of the silage by feeding trials.**] Diss. Breslau. *Landw. Jb.* 82. 215-52. 1935. [Inst. f. Grünlandwirtschaft, Preuss. Versuchs- u. Forschungsanst. f. Tierzucht. Tschechnitz] **437**

Experience gained in previous years at Tschechnitz is discussed (see Tiemann and Rehm, *Herb. Abstr.* 2. 254-5. 1932, and Tiemann, *Herb. Abstr.* 3. 15. 1933). The author has conducted experiments in the ensiling of lucerne by the cold fermentation process (a) in silos with airtight covers, and (b) with the aid of an acid. Whereas the former process produced wholesome silage free of mould, there was a 20 per cent loss due to mould and rot in the top layer of fodder

ensiled by the acid process, a fact attributed not to the process itself, but to the dry weather. Loss of nutrients due to respiration between cutting and ensilage were insignificant. The nutrient content and digestibility of the two forms of silage are compared, as well as their effect upon milk and fat production.

REID, W. D. **The preservation of silage.** *N. Z. J. Agric.* 51. 139-43. 1935. [Mycological Lab., Plant Res. Sta., Palmerston North, N.Z.] **438**

The best material used for ensilage in these experiments was obtained from untreated but wilted succulent ryegrass mixed with white clover and the poorest from non-wilted succulent ryegrass or mixtures of coarse ryegrass and cocksfoot normally considered too mature for this purpose. It was found that the quality of the silage can be improved by the addition of lactic-acid organisms, hydrochloric acid, whey and molasses. Of these whey and molasses, alone or combined, are the best for farm practice in that they are the cheapest sources of sugars available and at the same time give excellent results when applied to many types of herbage.

RUPEL, I. W., ZEHNER, C. E., PETERSON, W. H., and STEFANIAK, J. J. **It's best to use preservative with alfalfa silage.** Wisconsin Agric. Exp. Sta. Annual Report 1942-1943. Part II. Bull. 463. (What's new in farm science.) 1944. pp. 26-7. [Madison, Wisc.] **439**

Alfalfa, ensiled without a preservative, showed a top layer 8 to 16 feet deep which was unfit for feeding, but alfalfa mixed with corn-and-cob meal showed only the normal amount of top spoilage. Using about 200 lb. of corn-and-cob meal with each ton of alfalfa, the silage in February had a pH of 4.48, an average dry matter content of 31 per cent and a carotene content of 70 μg. per g. of dry matter; it was well preserved throughout, containing no moulds or "pockets." Cows showed a preference for, and did better on, the alfalfa-grain silage. From a feeding trial with Holstein cows, it appears that the grain does not lose its feeding value by being used as a silage preservative. [D. S. A.]

RUSCHMANN, G. Vergleichende Untersuchungen über das Defu- und Penthesta-Verfahren bei der Einsäuerung von Grünfutter. [**A comparison of the "Defu" and "Penthesta" processes for ensiling green fodder.**] *Landw. Jahrb.* 78. 169-207. 1933. [Forschungsstelle f. landw. Gärungen, Berlin] **440**

"Defu" solution is a commercial preparation containing about 30 per cent HCl and 1 per cent H_3PO_4, and is similar to that used in Finland in the AIV process. "Penthesta," a preparation made by the I. G. Farbenindustrie, is pentachloride of phosphorus, which

when water is added divides into 1 mol. phosphoric acid and 5 mol. hydrochloric acid. It is easier to transport and handle than Defu. The difference in the effect of the two solutions was not great, but Penthesta was found to be slightly superior to Defu in most respects, and is probably more effective and reliable in the ensilage of difficult material. The material used was (1) freshly mown grass, (2) somewhat harder and longer grass from irrigated meadows (as a rule especially difficult to ensile on account of its high protein content), and (3) fresh young lucerne ; all unchopped.

RUSCHMANN, G. Trockenmolke als Sicherungszusatz bei der Einsäuerung jungen, eiweissreichen Grünfutters. [**The addition of dried whey for the successful ensilage of young green fodder with high protein content.**] *Dtsch. landw. Pr.* 68. 185. 1941. **441**

RUSCHMANN, G. Weshalb keine natürlich Gärfutterbereitung ? Erwiderung auf die Kritik von Dr. W. Speer. [**Why no natural production of silage ? Reply to the criticism by Dr. W. Speer.**] *Z. Tierernähr. Futtermittelk* 6. 92-4. 1941. **442**

Ruschmann considers formic acid to be an unnatural and potentially toxic addition to silage. [N. A. and R.]

RUSCHMANN, G. Die Verwertung von Gärfuttersaft. Aufbewahren und Haltbarmachen von eiweissreichem Grünfuttersaft. [**The utilization of silage juice. Storage and conservation of green fodder sap rich in protein.**] *Forschungsdienst* 17. 197-204. 1944. [Bakt. Abt., Inst. Bodenk. u. PflErnähr., Landsberg/Warthe] **443**

An account is given of experiments conducted at Landsberg-on-the-Warthe, Germany, the material comprising the expressed sap of legumes and some other plants. The importance of sugar as a preservative was demonstrated and also the necessity for air-tight covering, obtained in the experiments by means of a 4 mm. thick cover of paraffin. The use of a bacterial inoculant was also found helpful.

RUSCHMANN, G., and BARTRAM, H. Die Einsäuerung jungen, eiweissreichen Grünfutters mit Trockenmolke. [**Ensiling young protein rich green fodder with dried whey.**] *Zbl. Bakt. II.* 103. 193-224. 1941. **444**

A large number of laboratory experiments are reported in which dried whey was added to lucerne and Landsberg grass mixture to promote better fermentation, improve keeping properties and reduce wastage. An interesting feature of the experiments was the distinct difference noted in the behaviour of the lucerne and the Landsberg grass mixture during the fermentation process. [D. S. A.]

RUSCHMANN, G., BARTRAM, H., and RINCKLEBEN, P. Einsäuerung von Saft aus jungem, eiweissreichem Grünfutter unter Zusatz von Trockenmolke. [**Ensiling juice of young, protein-rich green fodder with dried whey.**] *Zbl. Bakt. II.* 105. 73-95. 1942. **445**

A detailed chemical and bacteriological study is reported of the fermentation process which takes place during the ensiling of the juice of young, protein-rich green fodder using dried whey as a source of sugar. The juice used in the experiments was obtained in the laboratory by pressure from a Landsberg grass seed mixture; it is claimed that it was equivalent to the juice which leaks out from the silos during normal ensiling of this grass mixture. [D. S. A.]

RUSCHMANN, G., and DUNCKER, L. Die Einsäuerung von Luzerne mit verschiedenen Salzsäure-Phosphorsäure-Gemischen. [**Ensiling lucerne with different hydrochloric and phosphoric acid mixtures.**] *Landw. Jahrb.* 80. 497-520. 1934. **446**

SCHARRER, K., and SCHREIBER, R. Über die Verwendung von Sauerkartoffeln bei der Einsäuerung von Luzerne. [**On the use of potato silage for the ensilage of lucerne.**] *Biederm. Zbl. B. Tierernähr.* 14. 317-34. 1942. [Agrikulturchem. Inst. Univ. Giessen] **447**

Lucerne was ensiled by means of adding (a) and (b) acids, (c) 10 per cent steamed potatoes, (d) 5 per cent ensiled and steamed potatoes. None of the lucerne silages could be judged "good" although they were readily taken by the experiment animals. Data on the digestibility of the various components of the silages are presented.

SCHEFFER. Neues auf dem Gebiet der Gärfutterbereitung. [**New ensilage technique.**] *Mitt. Landw.* 55. 690-2. 1940. [Professor Univ. Jena] **448**

After a discussion of ensilage from the purely biological standpoints and a report on experiments in the use of home products as additions (sugar, skim milk, sour milk, and recently potatoes also), the author speaks of the effect of adding steamed potatoes. Experiments have proved that these last-named are a valuable addition in the ensilage of fodder plants rich in protein and that a good product is obtained by this means. For every 3-4 dz. green fodder 1 dz. steamed potatoes is necessary, to be well mixed with the green plants, evenly spread and firmly trodden down. The process is considered to be of much importance for farms that grow large quantities of potatoes and are organized less for pig rearing than for cattle. Another proposal is made by Nehring, whereby green fodder is ensiled with potatoes in a ratio of 1 : 3 or 1 : 4, that is to say, in reverse proportion to the process described above. The

product thus obtained is intended for the piggery. Nehring considers that in this manner it is possible to make the protein of the green fodder plants avilable for the feeding of pigs. The protein-starch ratio of 1 : 10 thus obtained in the silage is naturally much wider than that described above. The desire is expressed that both processes may be tested by as many farmers as possible.

SCHEFFER, F., and BURKHARDT, E. Grünfuttereinsäuerung unter Zusatz von Sauerkartoffeln. [**Ensilage of green fodder by means of adding ensiled potatoes.**] *Mitt. Landw.* 56. 698-9. 1941. [Univ. Jena] **449**

Experiments in the ensilage of different herbage plants with the addition of two-and-a-half year old potato silage were conducted as follows : (1) Landsberg mixture [*Trifolium incarnatum, Vicia villosa* and *Lolium italicum*] plus 10, 20, 30 and 50 per cent respectively ensiled potato, hydrochloric acid and no addition for comparison ; (2) lucerne plus 10, 20 and 40 per cent potato, 1 per cent sugar addition for comparison ; (3) lucerne and meadow grass ensiled with the addition of steamed fresh potatoes to compare with other containers in which the same plants were ensiled with the addition of ensiled potatoes. The results are considered successful. In the case of (1), the addition of 10 to 20 per cent potato silage was found insufficient, but 30 or 50 per cent additions—especially the last-named—resulted in a " very useful silage with good properties." In the case of (2), only the 40 per cent potato addition produced fairly good or good silage. In (3), 30 and 50 per cent ensiled potatoes gave good results, but steamed potato additions gave poor results in the lucerne, although they were successful with grass. It is considered that potato additions should not constitute less than 30 per cent of the silage, as 10 or 20 per cent were not always found sufficient to ensure success.

SENESSE, G. Ensilage d'herbe de prairies naturelles en meule, avec apport d'acide. [**Ensilage of herbage from natural meadows, in stacks with the use of acid.**] *J. Agric. prat. Paris.* 100. 348-9. 1936. [Director, Ecole Herbagère de Beauregard] **450**

Full directions are given for the formation of the stack and the making of the silage. The grass should be as far as possible freshly cut and not too mature, but half-wilted grass may be used, in which case the acid solution must be applied more liberally. A discussion of costs in conjunction with nutrient value shows the profitability of the process.

SHARROCK, J. N. **Making silage.** *J. Minist. Agric.* 54. 505-7. 1948. [N.A.A.S., Maidstone, Kent] **451**

Young leafy herbage rich in protein can be ensiled with certain

success, provided that (a) molasses is added to the leafy greenstuff, (b) the material is filled into the silo evenly, (c) the temperature is controlled so that the mass reaches a temperature of about 100°F. (blood heat), and (d) the container is then sealed to exclude air and rain. Surface drainage must also be excluded. Details are given of a practical example of silage making, the team consisting of two men, provided with a tractor, a mower, a side-delivery rake, a low-loading trailer and two 4-tined forks.

SHEPHERD, J. B. **Wilted grass silage makes fine feed.** *Fmr's Wkly* 75. 101-3. 1948. [Div. of Nutrition and Physiol., U. S. Bureau of Dairy Science] **452**

The practical requirements of the wilting method of making good grass silage and the method of constructing a simple, inexpensive moisture tester are described. An air-tight silo is essential, otherwise considerably mouldy silage will result. Legumes and immature grasses should be wilted only slightly after they are cut; the average moisture content when put in the silo should vary between 60 and 68 per cent, and definitely not less than 60 per cent if a trench silo is used. Time required to wilt to this desired moisture content will depend on the crop and weather conditions, varying from a few minutes after cutting during prolonged dry spells to two or three days during rainy spells. The correct stage for rapid ensilage is reached when, upon rubbing the chopped crop material between the hands, the bruised stems and leaves will feel cool and moist, but not wet.

Rain wet portions of the crop can be ensiled without wilting by filling the silo slowly at the rate of 3 to 4 ft. a day, without trampling, so that some heat will be generated; as it can be ensiled at a normal rate by running 10 to 20 per cent of dry hay or 5 to 12 per cent of ground dry grain or 3 to 4 per cent of molasses (by weight) through the cutter along with the wet crop.

It is usually advisable to cut no more at one time than can be ensiled in half a day so as to avoid excessive wilting. Chopping the crop fine is essential; the cutter should not be set for a cut longer than one-third of an inch, a setting of a quarter of an inch is to be preferred. This facilitates quicker packing, less fermentation, a better type of fermentation, a more palatable silage and an increase in the quantity of the crop that can be put in the silo.

Four to six feet of heavy-finely chopped, unwilted silage should be put on top of the silage so as to force out what air remains in the ensiled material and to keep other air out. Failure to do so will result in top spoilage and extensive areas of small mouldy spots down several feet of the wilted portion. Tramping and packing the top properly during this period is also essential.

SHEPHERD, J. B., and WOODWARD, T. E. **Experience in ensiling partially cured alfalfa, methods used, losses sustained, and feeding value.** [Abs. of paper for 33rd Ann. Meeting, Amer. Dairy Sci. Assoc., June, 1938.] *J. Dairy Sci.* 21. 104-5. 1938. [Bur. Dairy Ind., U.S. Dept. Agric.] **453**

STEENSBERG, V. AIV-foder og ensilage. [**AIV silage.**] *Ugeskr. Landmænd* 1938. 129-134, 150-3 and 164-7. **454**

This is a review article dealing with methods of silage making and experiments on the use of silage, especially AIV silage, in animal feeding. [N. A. and R.]

STONE, R. W., MURDOCK, F. R., and BECHDEL, S. I. **The fermentation in legume silage with wilting and with corn-and-cob meal as a preservative.** *J. Dairy Sci.* 26. 734-5. 1943. **455**

SWEDEN, Swedish Institute of Agricultural Engineering Medd. No. 205. Beredning och användning av AIV-foder. [**Preparation and use of AIV fodder.**] By *Y. Andersson* and *B. Grahn.* 1946. pp. 40. **456**

With the AIV method the losses of nutrients are less than in ensiling by fermentation. The method is very suitable for fodder crops with low sugar content and high protein content. As regards the preservation of the nutrients and vitamins of the fresh fodder, the AIV method is superior to the best hay-curing method, drying on frames.

The two main types of silos are pit and tower types ; there are also intermediate forms. All silos should be so placed as to save labour in extracting the fodder and feeding it to the animals. Tables are included showing (1) the capacity with varying diameter of the type of silo most general hitherto, i.e., the pit silo with a 1.5 m. deep undersilo and 2.0 m. high over-silo ; (2) capacity per metre of the effective silo height (= the height to which the fodder fills the silo after it has settled) ; (3) the feed value of the most usual kinds of AIV fodder.

Red clover, alsike and white clover are suitable for conversion into AIV fodder. Cutting should be carried out when the plants are in an early stage of development, preferably not later than the bud stage. The AIV method is of great importance for conservation of clover aftermath. Lucerne for AIV fodder should be harvested early, certainly before flowering.

Grass intended for AIV fodder should be harvested at the latest during panicle emergence. The method is particularly suitable for conservation of surplus grass from pasture leys. Oats and other cereal crops can be included in green fodder for AIV ensiling ; they must be harvested at the latest immediately after panicle or spike

emergence. Barley is less suitable, as it gives the silage a disagreeable smell.

Green fodder mixtures of legumes only (peas, vetches and horse beans) can be allowed to grow slightly longer than when cereals are included. They should be harvested at the latest during flowering. Lupin for AIV fodder should be cut before flowering in the main shoot is completed.

Marrow-stem kale for silage should be cut while it is still sufficiently leafy to form a compact mass in the silo. Root tops, potato tops and tubers, beet pulp and brewer's grains can be converted into AIV silage.

Surplus fish, fish offal and slaughter-house offal can be conserved by the addition of AIV solution.

The method of cutting and collecting the crops is described and the usefulness of the so-called " short-grass collector " is emphasized.

In the AIV solution diluted for use the proportions are : 1 part AIV solution to 6 parts water. Tabulated data show the amounts of AIV solution required for the various kinds of fodder. Test-weighings of fodder loads should be carried out several times in the course of a day. Directions are given for spraying the AIV solution, covering of the fodder in pit silos, and in tower silos, handling and estimating the value of the silage.

AIV fodder is of greatest importance for feeding to cattle, particularly dairy cows, but can also be given to sheep, poultry, horses and pigs. Breeding sows may receive 2-3 kg. per animal per day, young pigs 300-500 grm., and poultry up to 30 grm. The higher the fodder unit concentration of the silage, the larger are the amounts which it is possible to introduce into the cows' rations.

In a table are indicated five alternative rations for 500 kg. cows with a production of 20 kg. 4 per cent milk and a nutritive requirement of 10.8 fodder units together with 1250 grm. digestible protein. In feeding with AIV fodder a special addition of minerals is necessary.

SWEDEN, Swedish Institute of Agricultural Engineering Medd. 216. Ensileringsmetoder, silor och mekaniska hjälpmedel för ensilering. [**Methods, silos and labour-saving devices in silage making.**] By *F. Jarl* and *Y. Andersson*. 1948. pp. 83. [English summary pp. 77-83.] **457**

Under Swedish conditions it is particularly important to make silage from material rich in protein and therefore the usual method of cold fermentation cannot be recommended. To determine the extent to which it is possible to use in Sweden the modified American method of cold fermentation with some wilting of fodder in the field, large-scale experiments would be necessary. The merits or advantages under Swedish conditions of using various preservatives

(AIV solution, formic acid, phosphoric acid, sugar, molasses, concentrated whey) are discussed, and there is information on nutritive value and palatability of the silage produced. Other aspects considered are the construction of silos, mechanization, and labour problems.

TIDSSKRIFT FOR PLANTEAVL. Ensilering of Roetop. [**Ensiling of root tops.**] *Meddel. Statens Forsøgsvirksomhed i Plantekultur* No. 369. *Tidsskr. Planteavl* 50. 171-4. 1945. **458**

In continuation of earlier ensiling trials, during 1941-1943 a series of trials was carried out with root tops to determine the loss of dry matter and of protein and to ascertain the quality of the silage with different ensiling methods. Results confirmed those of the earlier trials, indicating that the AIV method was the most reliable and showed the smallest dry matter and protein losses and the best quality of silage, but acid should be applied in such an amount that the reaction figure is always below 4. Amasil is a valuable substitute but has given a somewhat larger loss of protein and slightly poorer quality silage. The addition of molasses has resulted in a larger loss of dry matter and of protein and a poorer quality silage.

TROITSKY, I. A., and KLIMOV, N. M. **Preservation of green grass.** *Problemy Zhivotnovodstva* 1935. No. 12. 83-9. **459**

A preliminary experiment is described in the preservation of green plants which have not the required sugar minimum necessary for silage by the use of HCl, lactic acid and phosphates. The fodder was stored in hermetically sealed glass jars.

Different acids were tried, inclnding mixtures of HCl and lactic acid ; HCl, lactic acid and lime. The pH of the mixture was determined electrometrically. The temperature was noted. Grass without any preservative served as a control, and after a month began to rot and was covered with moulds. The composition of the best preservative is not given as further experimental work is necessary. [N. A. and R.]

ULVESLI, O., and GJELSTAD, B. Fortsatte undersøkelser over ulike ensileringsmåter. [**Further investigations on different methods of ensiling.**] *Norsk Landbr.* 14. 183-6. 1948. **460**

Some investigations on ensiling methods were reported in this Journal in 1945 and 1946. The work has been continued and a summary is now given of the results from the laying down of the first cut in 1946. The raw material consisted of 90 to 95 per cent clover and 5 to 10 per cent timothy cut in an early stage of development, before any clover heads were visible. The yield was about 3800 kg. per dekar. The following methods were compared.

Container	Pressure per sq. m. in kg.	
1	500	Whole clover according to AIV method
2	500	Chopped clover according to AIV method
3	2500	Whole clover without admixture
4	2500	Chopped clover without admixture
5	1500	,, ,, ,, ,,
6	1500	,, ,, ,, ,,

The silage was investigated in 1947. In ensiling this material (first cut, rich in clover) without application of conservation liquid, it was not possible to reduce the loss by using greater pressure than 500 kg. sq. m. Lower pressure was not tested.

The loss of dry matter is approximately twice as large and the loss of crude protein three to four times as large when the material is put down without admixture as when the AIV method is used. The protein in the AIV silage was digested better than in the silage without admixture.

UNGLAUB, H. Zusatz von Ammoniumbikarbonat zu Gärfutter zwecks Erhöhung seines Eiweissfutterwertes. [**Increasing the protein value of silage by adding ammonium bicarbonate.**] *Biederm. Zbl. B. Tierernähr.* 8. 238-42. 1936. **461**

Trials were carried out to determine the type of silage to which NH_4HCO_3 could be added so as to raise the feed value. The silage must consist of easily fermentable plants and should not have a pH higher than 4.0. [N. A. and R.]

UNITED STATES, Department of Agriculture. Tech. Bull. No. 611. **Methods of making silage from grasses and legumes.** By *T. E. Woodward* and *J. B. Shepherd.* 1938. pp. 33. **462**

Using *Dactylis glomerata, Poa pratensis, Phalaris arundinacea, Trifolium repens, Lespedeza, Glycine* and *Medicago sativa,* experiments were conducted to study the more important problems in making silage. Fresh green grass either alone or mixed with legumes, and also fresh green alfalfa when chopped and placed in the silo, kept without moulding or rotting and the losses of dry matter and carotene were low. Partial drying before chopping increased the surface spoilage, increased the temperature of fermentation and in most cases improved the palatability. The addition of dilute acids lowered the palatability but helped to preserve the carotene content. The dry matter content of the grass and the nitrogen content of the alfalfa were also favoured by the acid treatment. Molasses improved the palatability of both grass and alfalfa silage.

Good grass silage was quite palatable and mixtures of unpalatable grasses with legumes were made into silage which was

considered equal in palatability to that of hay made from similar mixtures. Alfalfa silage appeared less palatable than grass silage made in a similar manner. A high moisture content of the alfalfa silage (above 70 per cent) was associated with offensive odours. The odours could be improved by partial drying or by the addition of dilute acids.

Data on feeding trials are given. The advantages of chopping and the exclusion of air, and of draining pit silos are recorded.

UNITED STATES, Department of Agriculture. Leafl. No. 238. **Making grass silage by the wilting method.** By *T. E. Woodward.* 1944. pp. 4. **463**

Essentials in making good silage are exclusion of air, fine chopping of material and a correct moisture content of the chopped material. This should be between 58 and 68 per cent. A moisture content above 68 per cent is especially bad for the legumes causing offensive odours in the silage. The wilting method of making silage has been developed to obviate the need of preservatives. The crop is left in the field until the proper moisture content has been reached. On a good drying day 2 hours in the swath should be enough. It must be borne in mind that the more the crop is dried the greater is the loss of carotene. A home-made moisture tester is described.

VIEWEG, K. Kan kraftfoderanvändningen inskränkas eller helt undvaras genom bättre utnyttjande av våra hemmaproducerade fodermedel, särskilt med hänsyn till AIV-metoden? [**Can a reduction be effected in the employment of concentrated fodder or can its use be wholly dispensed with by better utilization of our home-produced fodder, particularly with regard to the AIV method?**] *Svensk Frötidn.* 3. 87-93. 1934. **464**

The writer points out that the AIV method is not cheap and that it is economic only as regards protein. It should, however, be emphasized that it is not intended that this method shall replace hay curing when conditions for that work are good, but that the best economic results are obtained by utilizing the method for valuable, protein-rich fodder, which when fed to the animals reduces the protein requirement.

Swedish farmers with the assistance of the AIV method have in their home-produced fodder a good substitute for imported oil cake, when it is a question of a production of approximately 20 kg. milk per cow per day. With higher production, however, the use of a certain percentage of oil cake must be continued, as otherwise the fodder ration becomes too bulky and poor in protein.

VIRTANEN, A. I. **The AIV-method of preserving fresh fodder.** *Empire J. Exp. Agric.* 1. 143-55. 1933. [Co-op. Butter Exp. Assoc., Valio, Helsinki] **465**

The basis of fodder preservation is to prevent the breakdown of protein and it has been shown that this will not occur in a fodder with a pH below 4. Respiration of plant cells and butyric fermentation is inhibited in acid conditions: thus the idea arose that fodder should be treated with acid to raise the acidity of the mass to a point below pH 4 but not below pH 3 as this is detrimental to animals. Graphic results show that different kinds of plants require varying amounts of acid to bring acidity to a given point. Legumes require more than timothy for example. Also the lime content of the soil in which a plant grows affects this amount of acid required. For economic reasons only strong mineral acids should be used and tests carried out show that these acids have no detrimental effect on animals feeding on the acidified fodder, but that sulphuric acid should not be used alone as a preservative. The amount of nutrients in the effluence from AIV fodder is small and thus the question of containers is simplified.

VIRTANEN, A. I. **5 years' experience of AIV-fodder.** *Contr. Lab. Valio* 1934. No. 2. pp. 25. **466**

The author reviews the progress which has been made in Finland and numerous other countries in the study and use of the AIV method of fodder conservation. (See *Herb. Rev.* 3. No. 2. 1935 for further details.)

VIRTANEN, A. I. **The AIV process in theory and practice.** *Mon. Bull. agric. Sci. Pract.* 27. T.371-93. 1936. **467**

The AIV method of silage production is based on the principle that the decomposition processes in the fodder, especially the respiration of the plant cells, the breakdown of proteins, and harmful fermentations, caused by *B?. coli* and butyric acid bacilli, are prevented by an addition to the fodder at the time of ensiling, of a sufficient amount of acid to raise the acidity of the mass to pH 3-4.

Since no appreciable decomposition takes place in AIV silage, its digestibility remains approximately the same as that of the raw material and losses are limited to those of dry matter.

These are the laboratory findings, and the AIV process is claimed to be the most successful in dealing with high protein crops.

A description of methods of ensiling is given with full instructions as to the treatment of the green material with acid, directions as to the method of feeding and quantities to include in rations for stock.

This is one of the best of the author's accounts of his process. [N. A. and R.]

VIRTANEN, A. I. AIV-systemet såsom grundval för husdjurens utfodring. [**The AIV system as the basis for the feeding of animals.**] 22 × 15. pp. 304. Stockholm: LT:s Förlag. 1945. 15s. **468**

The Swedish edition of the book (translated by Dr. C. A. G. Charpentier from the second Finnish edition) was published because of the increasing popularity of the AIV method of fodder conservation in Sweden, and for the convenience of the Swedish-speaking farmers in Finland.

The book is divided into two main sections. Part I deals with the basic principles of the AIV method ; losses of nutrients with the AIV method ; conservation of vitamins ; quality of the fodder and its evaluation ; AIV fodder and health of the animals ; raw material for conservation ; home-produced nitrogen (the author's farm has for 10 years been so managed that no N fertilizers and concentrated feeding stuffs have been bought in) ; the development of fodder cultivation with a view to the preparation of AIV silage ; the composition of AIV fodder ; the effect of AIV fodder in the feeding of cattle, horses, sheep, pigs, rabbits and poultry ; the effect of AIV fodder on quality of the milk and the milk products. Profitability of the AIV method ; comparison of this method with others for the conservation of green material.

Part II relates to the preparation of AIV in practice ; silos ; labour requirement and the possibilities of reducing it ; utilization of AIV fodder ; feeding of cattle (place of AIV fodder in feeding, use of minerals together with AIV fodder, preparation of feeding plans) and other animals.

VIRTANEN, A. I. **Silage by the AIV method.** *Econ. Proc. Roy. Dublin Soc.* 3. 311-42. 1947. [Biochem. Inst., Helsinki] **469**

Preservation of protein-rich crops by haymaking or ensilage is fraught with difficulty and accompanied by high nutritive losses of the order of 30-50 per cent in the former case, while losses of starch equivalent amount to 31-45 per cent in the usual ensilage methods, losses of digestible protein being still higher. In 1925 the author set out to find a theoretical basis for the prevention of decomposition due to respiration, fermentation and micro-organisms. Knowing that micro-organic activity is checked at pH 2, an attempt was made to determine a pH range which was effective but not physiologically injurious. Laboratory experiments had shown that fermentations (except lactic) and protein breakdown were arrested at pH 4, while respiration was weakened and ceased at pH 3. A pH of 4 appeared to be the lowest safe acidity, for above pH 4 ammonia and butyric acid were formed. Drainage of acid effluent was fundamental, since the pH rose and decomposition ensued when fodder remained in contact with acid solution. It was also shown that rapid acidification was essential and that strong acids were more effective than weak acids, while acid requirements varied with different forage plants, the amount increasing with protein content and being affected by the acidity and lime status of the soil.

Because the effective pH range varied from pH 3 to 4 it was not difficult to gauge the quantity of acid required in practice. The acids used (hydrochloric and sulphuric) could not be detected in the product because they reacted with metallic salts of organic acids and the proteins present. Experiments with ensilage on a laboratory scale are described, the degree of decomposition of carbohydrates being assessed from the amount of CO_2 produced, and protein breakdown from the ammonia in the effluent, assuming that only when decomposition passed the amino-acid stage did the protein value change. The experiments showed that these changes were exclusively functions of the pH of the silage, and that the decomposition processes depend on the pH of the fodder no matter what preservation methods are employed. Preservation is safe and efficient only below pH 4, and pH also serves as a criterion of quality, since below pH 4 the extent of the changes is known and ammonia formation is negligible. Between pH 3-4 lactic acid was still formed, but had an insignificant effect on the pH and little disadvantage since lactic acid has almost the same nutritive value as the parent sugar. Amino acids were well preserved, but above pH 4 some were decomposed much more rapidly than others.

While material losses of 1 and 2 per cent accompanied a pH of 3-4, they rose to about 5 per cent when effluent was lost from ensiled material of 20 per cent dry matter content. The nutritive losses were about 10 per cent, but in silage with a pH of 4.5-5 they amount to 30-35 per cent and exceed this when the pH exceeds 5. Protein losses at pH 3-4, in fodder of about 20 per cent dry matter content, are about 5 per cent, but as much as 30-40 per cent in ordinary silage.

In the first large-scale trials in 1928 cattle readily consumed about 40 kg. (88 lb.) daily, but ate much less when the pH was 3. Silage with a lower pH was eaten reluctantly, and when hungry animals ate larger amounts, their condition showed that it was unwholesome. No harmful effects were apparent however when cattle received artificially acidified silage over a long period. Although the naturally alkaline urine became acid, small additions of soda, ground limestone and especially disodium phosphate suppressed this effect, but were considered unnecessary with moderate rations. Eighteen years of practical feeding have shown that this silage is wholesome, and it has not upset animal health but actually improved the regularity of calving. Carotene was almost quantitatively preserved, and preservation of vitamins was good. The AIV method was widely accepted and practised in Scandinavian countries after 1929 as a means of preserving protein-rich fodders, and has now placed the curing of clover fields on an entirely new footing, three crops being taken between mid-June and September.

Red clover/timothy herbage ensiled 2-3 weeks before haymaking time together with ensiled aftermaths gave about 22 per cent more

feed units and 43 per cent more digestible protein than when made into hay and aftermath silage.

Blue lucerne and other legumes, tops of roots and potatoes are also suitable for AIV silage. It promotes the vitamin A potency of milk and early cutting favourably affects the content of protective substances, especially carotene, which rapidly decreases in amount towards the flowering stage. Carotene is of great importance in winter, for concentrated foods are almost devoid of it and the vitamin A potency of milk depends exclusively on the carotene of the fodders. The importance of this in human nutrition is discussed. Reference is also made to ensilage by adding sugars, and to the system of farming practised by the author in order to grow protein-rich crops for AIV silage without the use of nitrogenous fertilizers. The paper includes numerous graphs and tables and diagrams of experimental apparatus.

WACHTER, H. von. Ergebnisse von Grünfutterkonservierungs-Versuchen mit Zusatzmitteln. [**Results of green fodder conservation trials with additional agents.**] *Prakt. Bl. Pflanzenb.* 12. 188-98. 1934. [Landesbauernschaft Bayern.] **470**

The results of ensilage experiments are reported. In eight the material was grass, in seven legumes (red clover, winter vetch and field beans), and in one beet tops. Sugar and various commercial agents were employed. Ensilage of unchopped grass with sugar is successful only when the grass is very young, short and tender. Older grass (cut during or after flowering) must be chopped. The same is true of red clover. The adding of acids can improve the quality of silage. Questions of cost are discussed.

WASHINGTON STATE COLLEGE Agricultural Experiment Station Bull. 348. **Stack silage.** By *R. E. Hodgson* and *J. C. Knott.* 1937. pp. 34. **471**

For 3 successive years crops of (1) oats and peas and (2) grass were ensiled by the stack and by the tower methods. The quantities made were on a practical scale. The silage was palatable, of good quality and of high nutritive value. Full data are given of composition of the fresh material, composition and digestibility of the silage and losses from the silos. The loss due to spoilage in the tower silo was reduced somewhat each year by improvements in management. In general, it is stated, a good quality silage can be made in the stack with 90 per cent of the efficiency of the tower silage. The lower efficiency was due to spoilage and it is stated that much care must be taken in the construction of the stack. [N. A. and R.]

WIEGNER, G. **Nutrient losses in various food-conservation methods.** *Karjatalous* 11. 65-71. 1935. *Chem. Zbl.* 1935. i, 2909. **472**

Losses in the AIV process of ensilage (pH 3-4) are much less than in ordinary methods without acid addition or in field or artificial drying for hay. The ratio of crude : true protein is maintained in the AIV process. [N. A. and R.]

WINDHEUSER, C. Über einen Einsäuerungsversuch mit Zusatz von Ammonbicarbonat und Fütterungsversuch mit dem erhaltenen Gärfutter an Milchkühen. [**An experiment on silage making with addition of ammonium bicarbonate. Experiments on the feeding of dairy cows with silage.**] *Biederm. Zbl. B. Tierernähr.* 11. 139-46. 1939. **473**

A silage made from yellow maize with the incorporation of 1.5 per cent of ammonium bicarbonate showed no significant difference in quality or in effects upon milk secretion from two other silages made without the ammonium salt. [N. A. and R.]

WINDHEUSER, C., HOFFMANN, O., and OHLMER, E. Über Einsäuerungsversuche mit Zusatz von Ammoniak und Ammoniaksalzen. [**Experiments in silage making with addition of ammonia and ammonium salts.**] *Biederm. Zbl. B. Tierernähr.* 7. 372-81. 1935. **474**

Good quality silages, free from butyric but containing lactic and acetic acids, were obtained with maize and marrowstem kale when sprinkled with ammonia solution (2.5-7 per cent NH_3) in the making ; results were less satisfactory with grass, red clover, soybeans and mangolds. The use of ammonium carbonate and bicarbonate gave similarly good results with maize, less good with grass.

Digestion coefficients of true protein were higher and losses of protein lower, but of total dry matter higher, than in the corresponding silages made without any addition. [N. A. and R.]

WOODWARD, T. E., and SHEPHERD, J. B. **Corn silage made with the addition of urea and its feeding value.** *J. Dairy Sci.* 27. 648-9. 1944. [Bur. Dairy Ind., U.S.D.A.] **475**

Two methods of feeding urea to dairy cows were compared. Both groups received similar rations of urea, silage, low-protein concentrates and hay. Urea was ensiled with maize at the rate of 10 lb. per ton of maize, or simply mixed with the concentrates. The production of 4 gal. of milk per day was maintained by all cows over the 100 days of the (single reversal) experiment. The urea lowered the palatability of the silage and concentrates slightly. [D. S. A.]

ZIJLSTRA, K. Ein einfaches Pressfutterbereitungsverfahren in den Niederlanden. [**A simple ensilage process in the Netherlands.**] 2. Tagung Weide- u. Wiesenwirte. pp. 141-6. [English summary, 145-6.] 1933. **476**

ZUBRILIN, A. A. [**The principal results of 10 years' work of the Ensiling Laboratory, Federal Institute of Fodders.**] *Vest. seljskohoz. Nauk. Kormodobyvanie.* No. 1. 72-8. 1941. **477**

During the period 1930-34 this laboratory recorded many facts relating to the purely empirical methods of preparing silages from different plants as had hitherto been practised both in the Soviet Union and abroad. Teams of workers at the local experiment stations and at the Federal Institute of Fodders tackled different theoretical and practical problems, mapping out promising lines of enquiry and conducting propaganda among the State and collective farms for the greater use of silages. The years 1935-1940 were almost exclusively devoted to long and short-term research and to the dissemination among farmers of the new improved methods of ensiling elaborated by them in laboratory and field investigations.

The author showed that good silages can be prepared only from plants rich in sugars. A minimum sugar content in relation to proteins, amino-acids, alkaline salts or organic acids, phosphates, etc., required for the successful preparation of silages was determined, and the tables were composed showing, for each zone in the U.S.S.R., the ensiling qualities of different fodder plants as conditioned by their sugar content.

A method of ensiling plants with a reduced moisture content was elaborated by A. A. Mihin for the semi-arid and drought-susceptible regions of the U.S.S.R. The absence of bacterial fermentation and not the formation of lactic acid or CO_2 accounts for he good keeping quality of silages prepared from plants with 50-55 ter cent moisture content.

To prevent the loss of vitamins and other nutrient components, Zubrilin offered a method of artificially acidifying the silages ; it consists of adding to the fodder plants undergoing the process of ensiling a preserving mixture, 70 per cent of which is a 8-10 per cent solution of crude hydrochloric acid and the remaining 30 per cent an 8-10 per cent solution of sodium sulphate (Glauber's salt) in a quantity representing 4-7 per cent by weight of the raw material. Its extensive application for the preparation of silages from plants rich in proteins and vitamins has been approved by the Lenin Federal Academy of Agricultural Sciences.

The ensiling of distillers' grains, without the use of preservatives, was found to be practicable ; fresh material flows down the conduits towards storage pits (trenches) where, after the suspended solid matter settles down, the liquid part is removed from the surface ; the process is repeated until the storage space is full, when a layer of 20-25 cm. fluid is left on top to prevent the access of air ; experiments showed that a " corn-potatoes " silage thus prepared, with a pH 4.2-4.3, could be used as fodder throughout the year.

Mihin perfected a simple and accurate contrivance for the measurement of the acidity of silages (pH should be 4-4.2 in a good quality fodder), which is used extensively on State, and collective farms. Preliminary chopping of stems, and, particularly, of leaves of all plants from which silages are prepared is indispensable for producing a fodder of good quality. The procedure facilitates and accelerates the lactic acid fermentation so that the ensiling process is completed in 5-10 days.

Zafren found that 50-100 per cent of vitamin A was preserved in the artificially acidified silages ; in some instances a 60 per cent increase in the vitamin A content occured ; an explanation was given that carotinoid substances, such as xanthophyll, may be transformed into carotene in the silage of low pH value under anaerobic conditions.

ZUBRILIN, A. A., and MIHIN, A. M. **New data on silage.** *Problemy Zhivotnovodstva.* 1935. No. 7. 27-38. **478**

A discussion is given of the AIV process and of its possibilities. Establishment of a sugar minimun for plants is suggested, plants having a lower sugar content than the minimum being unfit for silage. Mineral acids are recommended for use with plants having a low but not a minimum sugar content. [N. A. and R.]

G. TYPES AND CONSTRUCTION OF SILOS

AIKKINEN, I. Om AIV- fodertorn. [**The AIV fodder tower.**] *Lantm. Svenskt Land.* 25. 515-7. 1941. **479**

During the first few years when the AIV method was employed, such fodder was conserved in Finland almost exclusively in pits. Nowadays the silo tower is considered to be superior as an AIV fodder container. Points dealt with include the most suitable place for an AIV silo tower, its size and construction, and protection of the fodder from cold.

ARCHIBALD, J. G., and GUNNESS, C. I. **Seepage losses from a silo.** *J. Dairy Sci.* 28. 321-4. 1945. [Massachusetts Agric. Exp. Sta.] **480**

In 100 experimental silos practically all the seepage occurred during the first 3 weeks with the maximum amount in the first week. Experiments conducted over a 7-year period have led to the elimination of most of the seepage through wilting of the crop, use of less succulent crops and addition of absorbent preservatives such as wheat and ground corn. Losses from seepage are insignificant when compared with losses from other causes such as mould or rot. Judging by chemical analyses of the juices, nutrient losses are very slight. Seepage should be allowed to drain off to avoid spoiling the quality of silage in the lower parts of the silo, but the ensilage process should preferably be managed, as indicated above, to keep seepage at a minimum because of the smell of the seepage and its attraction for flies.

AUTREY, K. M., KNODT, C. B., and WILLIAMS, P. S. **Grass and legume silage studies using 2-quart glass jars as miniature silos.** *J. Dairy Sci.* 30. 775-85. 1947. [Pennsylvania Sta. Coll.] **481**

Fermentation changes which occur in 2-quart glass jar silos are similar to those which occur in large commercial silos. As a measure of desirable fermentation, pH values were used, 60 lb. of molasses and 100 lb. of hominy feed respectively being equally effective as preservatives. Silages with straw added, and that wilted and having no preservative were of good quality and were well preserved, but generally were inferior to those in which preservatives were used. No destruction of carotene took place up to 30 days after ensiling ; in many cases there was an actual increase. The sugar content of the wilted silages was 40 per cent higher than the unwilted brome grass/ladino clover silage and 33 per cent higher than the unwilted orchard grass/ladino clover silage. After 60 days, samples were

analysed for crude protein content; this was 4.9 per cent less than that of silage 1 day old. "Analysis of variance of dry matter, nitrogen and pH values of the various silages studied here, revealed a coefficient of variation of less than 5 per cent in all cases and less than 2 per cent in some instances. This extremely low variability indicates that very accurate sampling can be accomplished by using glass jars as miniature silos."

BECHTEL, H. E., ATKESON, F. W., FENTON, F. C., and CARLETON, W. M. **Pit silos for the storage of Atlas sorgo grain and of soft corn.** *J. Anim. Sci.* 4. 438-52. 1945. [Kansas Agric. Expt. Sta.] **482**

Sorghum grain and heads and soft corn can be stored with moderate losses in pits in the ground for up to 8 months. Flooding is undesirable with grain, but chopping and flooding promotes better packing and less heating of sorghum heads in small pits. Chopping is advisable with soft snap corn (*Zea mays*). Large losses may be avoided by using larger pits and reducing the period of storage.

BELL, J. E. **Pits for silage.** *N. Z. J. Agric.* 75. 561-3. 1947. [Auckland] **483**

Silage is made in pits to save waste and to save the work involved in stacking the material. A well-built and well-covered stack made from young, succulent material will have only 3 to 6in. of waste at the sides, but an average stack of the same material has 12 in. of waste at the sides and 2 to 3 in. under the earth seal. With dry material the waste is usually 2 ft. at the sides even if building and covering have been well carried out. With a stacker most of the drudgery of stacking is obviated, but the operation of a stacker requires a gang of men, involving the employment of extra workers or obtaining them by co-operation. By using a pit the work can be carried out between milkings by the hands on the farm, assisted if necessary by one extra hand.

Pits and trenches should be accessible to two or more fields so that their use does not involve the cutting of the same area for silage every year. Unless the field is shut up for only a very short period, deterioration of the pasture is certain to follow cutting for silage year after year.

BENHAM, E. H. **Ensilage. The stack method.** *Tasm. J. Agric.* 14. 82-5. 1943 **484**

The advantages, requirements and final quality of five different types of silage produced by the stack method are given in detail.

BESLEY, H. E., and MCCALMONT, J. R. **Observations on the storage of grass silage.** *Agric. Engng, St. Joseph, Mich.* 22. 51-3. 1941. **485**

An original project at the New Jersey Station to measure the pressures exerted on silo walls by grass silage has been expanded to include investigations on juice control, protection of silos from action of silage acids, and harvesting methods and machinery.

BOND, J. R. **Trench silage.** *J. Minist. Agric.* 54. 72-6. 1947. **486**

The subject is discussed in regard to filling the silo, loading, sealing, and choice of site.

CASTAÑÓN, G. Silos para alfalfa. [**Silos for lucerne.**] *Agricultura, Madrid* 12. 130-1. 1943. **487**

Advice is given to a correspondent on the technique of ensiling lucerne and on the size and type of silo required. Cylindrical tower silos are recommended.

CUŘÍN, B. Výsledky pokusů se silážováním píce v komorách s lisem [**Results of experiments with ensilage in silo pits provided with a press.**] *Čsl. Zeměd.* 20. 205-6. 1938. [Inst. Biotechn. Anim. Prod., State Agric. Exp. Sta., Praha] **488**

Mixtures of peas with *Helianthus* and clover with sunflower were conserved in silo pits provided with a simple press according to Ontl's method. Analyses indicate that the ensilage has a high quality. Losses ranged between 4 and 3.2 per cent of the material. This method of ensilage is recommended for smallholders.

DIETRICH, K. Untersuchungen über den Einfluss des luftdicht schliessenden Deckels auf die Konservierungsvorgänge und die Güte bei Gärfutter. [**Effect of the use of air-tight covers on the preservation and quality of silage.**] *Biederm. Zbl. B. Tierernähr.* 9. 255-86. 1937. **489**

Small scale experiments were carried out in stoppered glass cylinders (and in cylinders in which the material was covered with clay) with chopped clover and chopped marrowstem kale with and without addition of CO_2, 0.75 or 1 per cent of sugar, or 8 to 10 equiv. of H_2SO_4 per 100 kg. silage, and large scale experiments in silos with chopped and unchopped clover, chopped and unchopped marrowstem kale, chopped bean plants and chopped vetch, 0.75 or 1.0 per cent of sugar and/or 10 equiv. of H_2SO_4 per 100 kg. silage being added in some cases. Silos fitted with air-tight covers and others in which the silage was covered with clay were used. When fresh material was ensiled, fermentation, especially in the upper layers, was inhibited by exclusion of air, the pH was increased and the lactic acid content decreased. The quality of the silage was improved by chopping and by the addition of sugar or of CO_2. The use of withered material had an unfavourable effect in the case of clover

but a favourable effect with marrowstem kale. In the air-tight containers production of CO_2 was almost completely inhibited by the addition of the H_2SO_4. The upper layers of the silage from the containers closed with clay were superior in quality to those from the air-tight containers. The extent of proteolysis was about the same in both types of container and experiments with wethers showed that the digestibility of the silage was also the same. [N.A. and R.]

DIJKSTRA, N. D. Proefnemingen over ensileering van gras in een silo met persdeksel (volgens het z. g. system Schmidt). [**Investigations on silage-making by means of a "press-silo of the Schmidt system."**] *Versl. Landbouwk. Onderzoek.* No. 51 (1). pp. 1-40. [English and German summaries, pp. 33-8.] 1945. **490**

This type is a circular, water-tight tower silo, in which the silage is compressed mechanically. A comparison was made over a 2-year period with ordinary silage in which the grass is sealed off and weighted down by means of a soil layer. It was concluded that a water-tight silo with pressure supplied by the soil layer is best.

ДОЛЖАНСКИЙ, Л. Надземное силосование. *Колхоз. Производ.* 1945. *No.* 7. стр. 28.

DOLŽANSKIĬ, L. [**Ensiling above-ground.**] *Kolhoz. Proizvod.* 1945. No. 7. p. 28. **491**

During harvesting and at other times much material suitable for silage is accumulated in various parts of the farm, but there may be no time, transport, nor labour to carry it to and ensile it at the place where silage is usually made. Emergency clamps offer the advantage of utilizing, during all weather, any greenstuff which becomes available from time to time. No chaffing or other equipment is required. The clamps can be situated at any convenient spot near the crop which is to supply their contents, and used gradually during the winter as required. Among the various materials clamped in the manner described, cabbage leaves made the best silage; but carrot, turnip, beet, and swede tops all formed good and palatable silage.

EDINBURGH AND EAST OF SCOTLAND COLLEGE of Agriculture. Bull. No. 10. [Re-issued]. **The making and feeding of silage.** By *H. H. Corner* and *A. M. Smith.* 1947. pp. 14. **492**

The best results in the making of quality silage and reduction of waste have been obtained from the trench silo with some modification of this system. Other methods of ensiling, including the clamp and stack are also discussed. Methods of making silage, its composition

and feeding to dairy cows, fattening cattle, breeding cows, store cattle and breeding ewes are given. Briefly the conditions required to secure good preservation are : cutting the crop at the proper stage of development, thorough teasing and tramping during the filling to exclude air, and sufficient covering and weighting afterwards to seal and keep the mass compact. For protein-rich material the crop must be cut in the young leafy stage, an interval of a day ot two should be allowed to elapse between filling successive layers so that a little heating takes place. Molasses is necessary to obtain proper preservation.

England and Wales, Ministry of Agriculture and Fisheries. Advisory Leaflet No. 243. **Making silage without buildings.** 1935. pp. 4. **493**

Information is given on all aspects involved in the preparation of trench, clamp and stack silage.

Fincher, F. **Grass silage. Pit and stack methods.** *J. Dep. Agric. Vict.* 30. 390-1. 1932. **494**

Gneist, K. Vergleichende Silierversuche zwischen festem Deckel und Lehmverschluss. [**Comparative trials in silage making with air-tight covers and earth covers.**] *Biederm. Zbl. B. Tierernähr.* 1. 66-83. 1935. **495**

Steel experimental silos were used with a crop of peas, beans and tares, half the silos being closed with an air-tight iron lid and the other half with a layer of soil. There was a bigger wastage due to spoiling of the top layers in the latter than in the former. Allowing for wastage there was a loss of 0.8 per cent of dry matter in the air-tight silos and of 8.4 per cent in the soil-covered silos. In the former there was a definite loss of N-free extractives and a very slight loss of crude protein and an increase in ether extract ; in the latter there was a more marked loss in protein and N-free extractives and also a loss in fibre.—[N.A. and R.]

Herforth, E. G. Untersuchungen über die Temperatur- und Druckschwankungen bei Einsäuerung von Grünfutter in Gärkammern mit luftdichtem Deckelverschluss und die Zweckmässigkeit eines Saftabflusses an Grunfutterbehältern. [**Studies of variation in temperature and pressure in the ensilage of green fodder in air-tight silos, and the question of the advisability of having an outlet for sap.**] *Landw. Jb.* 91. 618-41. 1942. [Inst. f. Grünlandwirtschaft, Kraftborn, Breslau] **496**

Herman, H. A., Ragsdale, A. C., and Heathman, W. **Trench silos for preserving cereals treated with molasses or phosphoric acid.** *J. Dairy Sci.* 24. 514-5. 1941. **497**

HILDEBRANDT. Besseres Gärfutter in besseren Gärfutterbehältern. [**Better silage in better silos.**] *Mitt. Landw.* 57. 374-6 and 389-90. 1942. [Berlin] **498**

An illustrated account is given of the structure of various types of silo : round and rectangular steel concrete silos, round wooden silos and trench silos with concrete plate covers. The technique of ensilage is also described.

JOURNAL OF THE MINISTRY OF AGRICULTURE. **Making grass silage in a clamp.** *J. Minist. Agric.* 47. 216-20. 1941. [Duthie Stock Farm, Aberdeen] **499**

Practical instructions are given. The best site, the dimensions, construction, filling and emptying are briefly discussed, and the advantages of such a method of treating grass are enumerated.—[N.A. and R.]

KIÁNEK, V. Požadavky zemědělcovy na silážní stavby a zkušenosti se systémem " Moravia." [**Requirements of farmers with regard to silos and experiences with the "Moravia" system of ensilage.**] *Časové Otáz. Zeměd.* 1936. No. 56. 62-6. **500**

The " Moravia " silo pit fully meets the requirements of the farmer. Analytic figures are given of a protein-rich ensilage (cereal-clover mixture) with and without molasses, which shows no difference in the content of nitrogen or acids.

KLIESCH, J., Die Einsäuerung von Zuckerrübenblättern in Erdgruben unter Verwendung von Silokreppapier. [**The ensiling of sugar beet leaves in trenches with the use of silo crêpe paper.**] *Zuckerrübenbau.* 23. 111-6. 1941. **501**

KOENEKAMP, A. H. Behelfsmässige Einsäuerung von Grünfutter. [**Makeshift ensilage of green fodder.**] *Mitt. Landw.* **59**. 835-6. 1944. [Säusenstein, Lower Danube] **502**

In the absence of a sufficient number of built silos and of the possibility of constructing them in war-time, the author urges the employment of straw silos as the best of the makeshift appliances. It is superior to the trench or pit silo as the product is incomparably cleaner. The frame is composed of bales of straw built up inside a widely spaced wooden fence. The height of the silo varies with the size of the straw bales ; the width should not exceed 6 metres, in order that material may be thrown in from both sides ; the length depends on the amount of material to be ensiled. Requisites for successful packing are : extremely hard trampling, preferably by heavy animals (an all-important point) ; the material not to be chopped, but spread lengthwise in layers ; chemical or other addition to be used in order to ensure acidification ; the top to be covered

not with earth, but with some readily pressed material such as poor quality beet leaf, valueless grass or weed growth.

KOENEKAMP, A., and UNGLAUB, H. Die Einsäuerung von Grünfutter in Pressstrohbehältern. Bericht über fünf Gross-Versuche im Herbst 1935. [**The ensilage of green fodder in silos of pressed straw. Report on five experiments made in the autumn of 1935.**] *Landw. Jb.* 84. 61-81. 1937. [Inst. f. Grünlandwirtschaft, Pr. landw. Versuchs- u. Forschungsanst., Landsberg (Warthe)] **503**

The process tested, which has been patented by J. Haimerl, consists in the erection of silos constructed of bales of straw. Experiments have been conducted in five localities under the supervision of the inventor. The results of chemical analyses, of a feeding trial, and studies of milk production and of costs are presented. While it will never be possible to obtain such good results in a silo of this nature as in one constructed of concrete, wood, or other of the customary materials, yet it is considered that the process furnishes a valuable emergency method, to be used, for example, in the utilization of surplus crops when all the available silo space has been taken up, or when the farmer has for some reason been unable to build ordinary silos.

KOK, E. A., and GUARAGNA, R. N. Estudo sôbre silos do tipo "trincheira." [**Study of silos of the trench type.**] *Bol. Indústr. anim., S. Paulo* N.S. 4. No. 3-4. 151-73. 1941. [Dept. Industr. Anim., São Paulo, Brazil] **504**

A full, illustrated account is given of three experiments in the ensilage of *Zea mays* (unchopped) and one in the ensilage of *Axonopus scoparius* in trench silos. The construction of the silos and costs are also considered. The maize gave much better silage than the grass. Preservatives such as hydrochloric acid reduce loss and improve quality but render the cost of maize silage excessive. The use of trench silos is not yet definitely recommended for the State of São Paulo, but the first year's trials show that it is practicable, and full directions are given for persons who may wish to experiment.

KRAUSS, W. E., HAYDEN, C. C., PERKINS, A. E., and WASHBURN, R. G. **A trial with temporary silos.** *Bi-m. Bull. Ohio agric. Exp. Sta.* 23. 71-6. 1938. **505**

The kind of temporary silo used was the paper-lined snow- or wicket-fence type, 8 feet in diameter. Chopped alfalfa was used and treated with either molasses or acid. A third silo was untreated. The losses in dry matter ranged from 50 per cent for the untreated to 83 per cent for the acid treated silage, and the method must

have been unsatisfactory. There was considerable loss of carotene in the untreated and acid treated silage but the molasses silage appeared to have gained in carotene content. It is concluded that alfalfa can be stored in these silos temporarily, but it is difficult to see the practical value of this. [N. A. and R.]

THE LONDON CORN CIRCULAR. **The sealing of silos.** May 24, 1948. **506**

The main purpose of a cover or " seal " on silage, according to the Ministry of Agriculture, is to reduce the risk of air getting into the herbage with consequent deterioration in feeding value from overheating and mould. This means not only avoiding exposure of the silage surface to air but also the consolidation of the upper layers of herbage so as to express air from the material. Excessive temperatures and moulds both develop quickly, so consolidation and sealing should be carried out as soon as filling is finished and should be regarded as an integral part of filling. The seal should keep the rain from getting into the silage container, but keeping the air out is even more important.

So, ideally, the seal should be air-tight and rain-proof and should be heavy, so as to compact thoroughly the upper layer of fodder. Where compaction can be carried out with a tractor, the seal will be required only to protect the silage surface from exposure to air and rain ; weighting of the seal in such circumstances is relatively unimportant. But when such effective means of final consolidation cannot be used, the silage must be weighted down immediately filling is completed. Unless the herbage is young and sappy, enough water should be applied to soak thoroughly the top layer of about 1 foot depth. This watering will lessen the risk of overheating by reducing temperature and will promote close packing of the surface material. If rapid and thorough consolidation cannot be undertaken, as is usual with stacks and with silos other than pits and clamps, the seal should be heavy but for tightly packed herbage an air-tight covering will be satisfactory.

For silage made in autumn by a method that allows of tractor consolidation—especially if it is intended to begin using the silage early in winter—it is doubtful if the surface waste avoided by a heavy covering justifies the expense. This, at least, is the opinion of some experienced farmers who make silage in a trench ; others are content to cover the heap with straw, bracken, rough mowings, and so on. If the silage will not be used for several months—generally material made in late spring or early summer—then a covering of 4 to 6 in. of soil is advisable. If the soil excavated for the trench is available for sealing, the labour cost should not exceed 3d. per sq. yard of surface covered. It is usually more expensive and laborious to cover other types of silo with soil. Materials easier to handle may

be used. Silage in containers can be covered with a 6 to 12 in. layer of wet brewers' grains, beet-pulp, sawdust or shavings, which can be well soaked and trodden down to provide a practically air-tight seal. These materials are not in themselves heavy enough to supply the compression necessary to exclude air so they should be thoroughly trodden. Additional weight can be got by superimposing concrete slabs and so on, laid on fencing posts, if it is necessary to spread the weight over a larger area. Some farmers have used cord-wood or straw bales for the same purpose, and even stacked hay on silage clamps made in spring; but some damage to the hay from moisture rising from the silage usually occurs. Whatever method is adopted to provide an air-tight seal, it is necessary to prevent rain from getting in, since the silage almost always shrinks away from the wall in the upper part of a container, so forming a water trap and resulting in more waste than will occur from this cause in stack silage.

MIRANDA, G. J. Parvas-silos. [**Trench silos.**] *Almanaque Min. Agric. Argent.* 17. 431-2. 1942. **507**

Methods of construction and use described for Argentine farmers.

NEW JERSEY Agricultural Experiment Station. Annual Rept. **Does silo leakage waste food material and what can be done about it?** 1941. p. 17. **508**

NEW JERSEY Agricultural Experiment Station. Bull. 731. **Pressures and other factors affecting silo construction.** By *J. R. McCalmont, W. C. Krueger,* and *C. Eby.* 1940. pp. 27. **509**

The factors considered are horizontal and vertical pressures, unloading pressures, capacity and density, seepage and drainage losses, leakage and spoilage. There are recommendations on materials and design for constructing silos.

NORSK LANDBRUK. Nedlegning av kalrotblad i staursilo efter AIV-metoden. [**Putting down swede tops in a stake silo according to the AIV method.**] *Norsk Landbr.* 4. 548. 1938. **510**

This method practised at the Agricultural School at Jønsberg, Norway, has given excellent results with swede tops, but has not proved so satisfactory with marrow stem kale. A stake silo can be set up quickly and cheaply, and can be placed in any position desired, thus reducing costs of transport of the leaf bulk. When the tops have been compressed in the silo the stakes are removed, earth being used to cover the sides of the mass. It is essential that the sap should have an outlet.

Pavlák, V. Pícní komory systému "Moravia" založené na principu vzduchetěsnosti. [**Construction of the "Moravia" air-tight silo-pits.**] *Časové Otáz. Zeměd.* 1936. No. 56. 66-73. [Dairy and Cheese School, Kreměříž, Moravia] **511**

The designer of the "Moravia" system of air-tight ensilage preparation describes the processes taking place during decomposition of organic matter. Forage may be conserved indefinitely as long as no air penetrates the pit. In this way samples have been conserved for 10 years in the Zootechnic Institute at Brno. Temperature has been found to have no essential influence on the conservation process. Some analyses are given of forage conserved by the system.

Quodling, H. C. **Some notes on silage with special reference to stacks.** *Qd agric. J.* 43. 170-85. 1935. **512**

Instructions on practical methods, with special reference to maize silage.

Reed, C. H. **A report of a silo survey.** *Agric. Engng, St. Joseph, Mich.* 20. 316 and 319. 1939 **513**

A survey of methods of construction and maintenance.

Rhodesia Agricultural Journal. **Silage and Silos.** *Rhod. agric. J.* 41. 333-6. 1944. **514**

Bull. 274 of the South Australia Department of Agriculture, by W. J. Spafford, is reprinted in view of the numerous enquiries concerning the weight of silage contained in different types of silo.

Sangenberg, S. Ensilaje económico del maíz verde. [**Economic ensilage of green maize.**] *Agricultor Venez.* 9. Nos. 103/104. 23. 1944. **515**

Construction and packing of a trench silo described.

Schmidt, J., and Kliesch, J. Einsäuerungsversuche unter Verwendung von Silo-Kreppapier. [**Experiments in ensilage with the aid of crêpe paper.**] *Forschungsdienst.* 12. 337-45. 1941. [Univ. Berlin] **516**

Experiments in ensilage in trenches lined with bituminized crêpe paper gave entirely satisfactory results. The material comprised in 1938 potatoes and sugar beet tops, in 1939 green clover. Experiments in 1940 with other types of paper (the bitumen and requisite solvent being imported and available in limited quantities only) gave varying results, but paper treated with coal tar has been found to be equal in value to the bituminized paper.

SMITH, H. C. **Temporary silos for grass silage.** *Agric. Engng, St. Joseph, Mich.* 21. 439-40. 1940. [Tech. Serv., Sisalkraft Co.] **517**

Considerable experience of temporary silos suggests that : (1) they should be lined with two sheets of treated paper ; (2) they should not be built more than a few feet higher than their diameter and if less than 12 feet high should be weighted ; (3) grasses should not be ensiled while rain is actually falling as excessive moisture in the ensiled material results in excessive drainage and loss of soluble materials ; (4) combinations of hydrochloric and sulphuric acids should not be used as preservatives ; (5) mixed crops (grasses and soybeans) are more palatable than single species and herbage with the highest moisture content should be ensiled last with plenty of preservative in the final loads, and finally (6) silage should always be chopped very fine.

SMITH, H. C. **Temporary-portable silos.** *Agric. Engng, St. Joseph, Mich.* 25. 336. 1944. [Sisalcraft Co.] **518**

The term " temporary silo " has been applied to the paper-lined, fence-ring type of emergency silo. Successive sections are set up as the silo is filled, but the height of the silo must not exceed its own diameter by more than 4 ft. The paper lining is used to exclude air and must be renewed for each filling of the silo. Preservation of the silage depends upon the uniform distribution of the fine and coarse particles, uniform packing of the finely chopped feed and a high moisture content.

The advantages are low initial cost, adaptability of size to requirements and portability, i.e. the possibility of changing its position from year to year. The fact that it can be built and filled in a day is a great asset to farmers with weather-damaged crops.

SWEDEN, Swedish Institute of Agricultural Engineering. Medd. No. 204. Hur man bygger silor för AIV-foder. [**Building silos for AIV fodder.**] By *Y. Andersson.* 1946. pp. 70. **519**

The walls of the silo must be smooth, perpendicular or slightly sloping outwards. The two main types—the pit silo and the tower silo—are described and illustrated. The arrangement of the outflow from the bottom of the silo requires careful attention.

The most suitable silo diameters for both pit and tower silos are :

For a herd with :	Diameter (metres)
1-7 cows	2.2 or 2.5
7-15	3
15-30	4
30-50	5
over 50	6

Tabulated data show the capacity per metre of the effective silo height.

The materials generally used in the construction of silos are wood and cement. Directions (illustrated by figures) are given for the construction of pit and tower silos and for intermediate forms. Outdoor silos not covered with soil in the same way as pit silos should be provided with a roof as a protection against precipitation. For sheltered positions a removable roof is more convenient, for exposed positions a fixed one.

TAMBE, G. C., and WAD, Y. D. **Silage making in mud-walled towers.** *Emp. Cott. Gr. Rev.* 11. 310-3. 1934. [Inst. Plant Industry, Indore, Centr. India] **520**

In the rain-fed areas of India and other places where rainfall is restricted to one season, natural green succulent fodder is available only for a part of the year; the livestock rations at other times consist of dry, fibrous grass or cereal crop residues of low nutritive value. The local cultivator is averse to growing crops merely for fodder, but it is suggested that the green grass which is abundant during the rains should be ensiled. Sufficient would remain for the subsequent hay harvest. A silage tower is described which costs no money and can be built by unskilled cultivators, after the proper technique of building and packing has been determined. Chemical analyses are given of silage made from *Andropogon contortus*, sorghum stalks, cowpea, soybeans, etc.

TAMM, W. H. **Effect of grass silage on silo pressures, seepage, disintegration and capacity.** *M. S. Thesis, Rutgers Univ.* 1941. **521**

TIEMANN. Bedeutung der Futterkonservierung im Silo mit luftdichtem Deckelverschluss. [**The importance of fodder conservation in silos with air-tight covers.**] *Mitt. dtsch. LandwGes.* 47. 833-5. 1932. [Preuss. Versuchs- u. Forschungsanst. f. Tierzucht, Tschechnitz] **522**

The employment of a perfectly air-tight and water-tight silo is a far more important condition of success than measures such as chopping, the adding of sugar, acids, etc. Further, with a silo which is satisfactory in this respect, it is possible to produce a good silage without any addition whatever, all other conditions for good ensilage (firm stamping-in, the chopping of unwieldy material, the filling up of the silo, etc.) being observed. The type of silo cover designed at Tschechnitz is described and compared with a commercial type.

TIEMANN, A. Novější zkušenosti a výsledky konservace píce v Německu. [**Recent experiences and results of forage conservation**

in Germany.] *Časové Otáz. Zeměd.* 1936. No. 56. 7-12. [Inst. Forage Crops Res. Tschechnitz, near Breslau] **523**

Information is supplied with regard to thirty different types of silos and on the conservation of about 5,000 q. of different forage. It is concluded that the air-tight type of silo is the most advantageous.

TIEMANN. Was ist bei der Einsäuerung von Grünfutter zu beachten ? [**Points to be observed in the ensilage of green fodder.**] *Mitt. Landw.* 54. 880-1 and 893-4. 1939. [Prof., Director Inst. f. Grünlandwirtschaft, Kraftborn, Silesia] **524**

The principal points to be observed for the successful ensilage of green fodder are briefly discussed for the farmer. (1) Trench silo or built silo ? (2) Erection of silo. (3) Wet or dry layering of the green fodder ? (4) Preparation of the fodder. (5) Should additions be used ? (6) Restriction of air during and after packing. In this connexion it is emphasized that the greatest care must be used in covering the silage. Covering must be quick, strong and compact. A simple roof as protection against the sun is generally recommended in order that no fissures form in the layer of loam or earth, but in the case of built silos with a cover this is not necessary.

TURNEY, T. H. **Grass silage in pits.** *J. Minist. Agric.* 53. 194-5. 1946. [Quinton Green, Northampton] **525**

Measures not laborious for producing silage of good quality are outlined.

VOEDISCH. Neue Wege des Silobaues in Thüringen. [**New methods of constructing silos in Thuringia.**] *Mitt. dtsch. LandwGes.* 48. 833-4. 1933. [Zwätzen, Jena]

TIEMANN and ROHE, P. Rund- oder Quadratsilo ? [**Round or rectangular silos** ?] *Mitt. dtsch. LandwGes.* 48. 1071-2. 1933. [Inst. Grünlandwirtschaft, Tschechnitz]

VOEDISCH, G. Rund-oder Quadratsilo ? [**Round or rectangular silos** ?] *Mitt. dtsch. LandwGes.* 48. 1090-1. 1933. **526**

Voedisch, after testing the relative merits of rectangular and round silos, concludes that the round concrete silo is the cheapest and most suitable form for general use. The chief difficulty of the local builder in constructing such silos, namely, the obtaining of a round mould for the concrete, has been solved in Thuringia by the construction of a number of easily transported moulds (eleven at present in use) which may be hired by farmers at a nominal cost. The size of the mould is determined by the average size of the Thuringian farms, and serves for the building of a silo of 14 to 28 cubic metres, 21 cubic metres being the most popular size. The same means of encouraging the practice of ensilage has been adopted in the Province of Hanover (seven moulds in use) and in other places.

Tiemann and Rohe, on the ground of many years' study of ensilage problems at the Grassland Institute, Tschechnitz, whilst not opposed to the use of the round silo in certain cases, enumerate the good points of the rectangular, and in particular of the two-chamber or four-chamber rectangular silo, and certain advantages which it possesses over the round silo.

In his reply Voedisch notes that his previous article was designed not so much to dispute the value of the rectangular silo for certain purposes, as to show that for farming conditions in Thuringia the round silo is undoubtedly the most suitable, and to describe the means by which the practice of ensilage, 2 or 3 years ago rapidly disappearing, has been given an impetus in Thuringia, so that several hundred new silos are in existence.

WOOD, L. **Fodder conservation in Queensland.** 2. **Silo construction.** *Qd agric. J.* 56. 309-22. 1941. **527**

H. COMPARISONS OF METHODS OF CONSERVATION

ACHTERSTRAAT, J. Resultaten van een onderzoek naar de voederwaarde van hooi en kuilover. [**Results of an investigation on the nutritive value of hay and silage.**] *Maandbl. LandbVoorlDnst* 3. 62-9. 1946. [Utrecht] **528**

Hay and silage from the region of Utrecht and south-eastern North Holland were studied in samples taken in 1943.

In 1944, sixty-four samples of ensiled grass from the same region were studied for chemical composition, which is tabulated for the different processes used (AIV, molasses, etc.) and the different cuts. The poorer results from using the first cut are probably due to late mowing. The effects of the different methods and different soil types on the chemical composition of the silage are compared.

AIKKINEN, I. Untersuchungen über die Wirtschaftlichkeit des AIV-Verfahrens im Vergleich zur Heutrocknung bei der Einbringung kleehaltiger Ernten. [**AIV ensilage of herbage with a high clover content compared with drying it for hay, a study of the economic aspect.**] *Suom. Maataloust. Seur. Julk.* 1938. No. 38. 1-125. [Univ. Helsinki, Finland] **529**

Two processes of conservation were compared, the material being taken from vigorous 1 to 2-year-old clover-timothy leys, altogether approximately 50 hectares, distributed over twenty-one farms in the West of Finland. By the first process the main crop was cut 2 weeks before the usual time for mowing hay, and it and the two successive cuts were ensiled by the AIV method. By the second process the main crop was mown at the usual time and made into hay, and the second cut was ensiled by the AIV method. Data presented include information on yield of fodder units, yield of digestible protein, losses incurred through haymaking and ensilage respectively, chemical composition of the hay and silage, influence of increasing proportion of clover, labour, and costs. Results in the main favour the first process.

AXELSSON, A. Vallfodrets förändring vid torkning och ensilering. [**Change of ley fodder in drying and ensiling.**] *Svenska Vall -o. MosskForen. Kvartalsskr.* 6. 285-94. 1944. **530**

The amount of dry matter in the finished fodder was largest when ensiled with molasses. With drying a comparatively large amount of fibre was newly formed, as the lignification process then continued. In AIV fodder conservation, on the contrary, a slight

loss of fibre occurred. Molasses silage occupied an intermediate position in that a small new formation of fibre took place when there was slight fermentation, while with active fermentation fibre was broken up, so that loss occurred.

AXELSSON, J. AIV-fodrets allmänna näringsvärde (energivärde). [**General nutritive value (energy value) of AIV fodder.**] *Landtm. Svenskt Land.* 22. 579-81. 1938. **531**

Practical experiments conducted in Scandinavia and elsewhere in which silage was compared with hay and with root crops indicate that the dry matter of AIV fodder is more nutritious than that of hay. The difference can be estimated at from 10 to 18 per cent. The nutritive value of AIV fodder is, on the other hand, lower than that of roots when compared on the basis of the amount of dry matter. For first-class silage the difference can be stated to be approximately 16 per cent, while for fodder obtained from a later cut the difference is considerably greater.

AXELSSON, J., GRAHN, B., WENNERSTRÖM, B., and FAGERLUND, N. Vergleichender Versuch mit Mineralsäureensilage (AIV-Futter) und Hackfrüchten (Kohlrüben) für Milchkühe. [**Comparative experiment with mineral acid silage (AIV fodder) and roots (swedes) for milking cows.**] *Lantbrukshogsk. Ann.* 5. 37-59. 1938. **532**

The experiment was conducted during the first half of the year 1935 at Ultuna, the estate of the Agricultural College of Sweden. For three series with eight cows in each, the basal fodder consisted of straw, hay and concentrated fodder. In series A, AIV fodder was included in addition, in series B, swedes, and in series C both AIV fodder and swedes. 1.08 kg. dry matter in the swedes corresponded to 1.25 kg. dry matter of the AIV fodder; the latter fodder offers, however, greater possibilities than roots when it is a question of basing milk production on home-grown fodder. No difference, between the fodder of the three series in regard to after-effect during the grazing period could be established. There is evidence that mineral content of the milk was not reduced by the AIV fodder and that after transition to pasture change in such content was independent of the cows' feed during the experimental period.

AXELSSON, S. Möjligheterna till ökad användning av hemproducerade fodermedel. Utfodringssynpunkter. [**Possibilities for an increased use of home-grown fodder. Feeding.**] *Svenska Vall- o. MosskFören. Kvartalsskr.* 2. 367-76. 1940. **533**

An account is given of the use of home-grown fodder in various provinces of Sweden, and the importance of ley fodder for the south

Swedish lowlands is recorded. The possibility of increasing still further the amount of home-produced fodder is discussed.

The feeding of dairy cows in recent years has been based increasingly on home-produced fodder. In place of oil cake, green fodder and straw pasture has been substituted during the summer, and AIV fodder and hay during the winter. This change has had a favourable effect on the yield of the cows (30 per cent higher than 25 to 30 years ago). If this development is to continue, further improvement of the quality of ley fodder is necessary. Thus the content of digestible protein must be raised and the content of fibre reduced if the necessary fodder consumption is to be attained. This can only be brought about by more and better pasture during the summer and also by earlier cutting and by better conservation of ley fodder for use during the winter. AIV ensiling and artificial drying are the best methods.

BOHSTEDT, G. **Nutritional values of hay and silage as affected by harvesting, processing, and storage.** *Agric. Engng, St. Joseph, Mich.* 25. 337-40. 1944. [Univ. Wisconsin] **534**

Carotene content is the best single criterion of quality in hay. High carotene content indicates a leafy hay which has been cut at an early stage of growth and cured with a minimum loss of leaves, which contain the highest feed value. In *Medicago sativa* leaves make up only 50 per cent of the total weight of the plant, but contain 70 per cent of the protein and 90 per cent of the carotene.

The original feed value of hay can be conserved most effectively by the retention of leaves, and by a rate of drying that quickly stops respiration, enzyme action and fermentation. An immediate transfer of the freshly cut forage to a vacuum oven followed by rapid drying at low temperature would be an ideal method of curing hay, but it has not been widely adopted for practical farm use.

The paper discusses cheaper methods of hay-making for retaining the feed value of the hay. Cutting in the early afternoon instead of morning is recommended. The advantages and disadvantages of field baling and field chopping are discussed.

Weather hazards are considered. Rainfall causes loss of the soluble vitamin B complex through leaching. Exposure to the sun, on the other hand, causes a loss of carotene. Lack of sunshine results in a deficiency of vitamin D in the hay, but this can easily be remedied by supplying vitamin D cheaply in other forms.

BRANAMAN, G. A., and DAVIS, G. K. **Legume silage vs. corn silage vs. legume hay for fattening calves.** *Quart. Bull. Mich. agric. Exp. Sta.* 22. 34-9. 1939; 23. 106-10. 1940; 24. 227-32. 1942 25. 13-6. 1942. **535**

Better quality feed is ordinarily possible under Michigan conditions in June from the making of molasses-legume silage than from curing the crop as hay. Machinery and labour conditions on the farm may not be suitable for silage making, however.

Gains in weight and market finish are superior when cattle are fed molasses-legume silage as compared with hay, especially hay somewhat weather-damaged, and when fed with moderately limited quantities of grain. Stated another way, more grain is required with the hay than with the silage to obtain equal gains.

A basal ration of corn silage and hay, properly balanced for protein, requires less grain for fattening cattle than does one of legume hay or molasses-legume silage. Differences in the amount of grain will depend upon the grain content of the corn silage and also upon the proportion of grain to that of hay or silage in the ration. The less the amount of total grain fed, the greater will be the effect of the other feeds.

BROUWER, E. **Comparative investigations of hay and ensilage.** *Versl. Landbouwk. Onderzoek* 35. 5-31. 1930 **536**

CHRISTENSEN, F. W., and HOPPER, T. H. **Digestible nutrients and metabolizable energy in certain silages, hays, and mixed rations.** *J. agric. Res.* 57. 477-512. 1938. [North Dakota Agric. Expt. Sta.] **537**

Determinations of nutritive value were made with sweet clover/oat straw silage, sweet clover silage, sunflower silage, corn silage, first and second cuttings of sweet clover hay, sweet clover stems, and *Avena fatua* L. The corn silage also served as a standard of comparison in feeding trials with group of stems. All the tests with sweet clover were made on the common white variety (*Melilotus alba* Desr.). Silage from sweet clover, sunflower and corn were generally higher in ash, crude protein, crude fibre and ether extract, but lower in N-free extract than the crops when ensiled. Compared on a dry matter basis, the sweet clover silages and hays resembled alfalfa hay in percentage of digestibility, digestible nutrients and metabolizable energy, but the sweet clover silages averaged a little higher in digestible crude protein and total digestible nutrients. Sunflower silage was less palatable than the sweet clover silages and these were less palatable than the corn silages.

CRICHTON, A., and CRICHTON, J. A. **Grass conservation.** *Scot. J. Agric.* 17. 276-81. 1934. [Rowett Res. Inst., Aberdeen] **538**

Methods of conservation are considered in relation to the nutritive value of the resulting products, (1) hay, (2) silage, and (3) dried grass.

DAVIES, W. L. **The conservation of grass.** *Indian Fmg* 2. 119-23. 1941. [Director of Dairy Res., New Delhi] **539**

Aspects discussed are preservation of carotene, protein and carbohydrate, ensilage, grass drying, hay-making and modern trends in preservation.

EDIN, H., BERGLUND, N., and ANDERSSON, Y. Undersökningar angående grönfoder samt metoderna för dess konservering II. [**Investigations concerning green fodder and methods for its conservation. II.**] *K. LandtbrAkad. Handl. Stockh.* 72. 297-392. [English summary, 386-92.] 1933. **540**

When cultivated on soils which are not too light or too peaty, the rotation hay crops of Central Sweden are generally composed of late-flowering *Trifolium pratense* (with some *T. hybridum*) and *Phleum pratense*, while the aftermath during the first year consists chiefly of clover. The feeding value of such forage has been tested in connection with various investigations. Tabulated data deal with chemical composition, nutritive value and digestibility and with their seasonal variations. Investigations have also been made in the preservation of clover aftermath, either as hay (natural drying on wire racks, drying with furnace gases in a rotary kiln, and drying at low atmospheric pressure) or as silage.

FARRANT, S. J. **Hay and silage on the farm.** *Pap. 3rd Oxford Fmg Conf.* 1938. pp. 90-103. [Discussion, 103-8.] [Burcote, Oxon.] **541**

FRENCH, M. H. **The comparative feeding values of grass when fed green, as hay, and as silage.** *E. Afr. Agric. J.* 4. 261-4. 1939. [Vet. Dept., Mpwapwa, Tanganyika] **542**

GREENE, H. T. **Farm experience in forage curing.** *Agric. Engng, St. Joseph, Mich.* 18. 448. 1937. [Brook Hill Farms, Wisconsin] **543**

Stress is laid on the advantages of preserving green forage in the most natural state and the difficulty of obtaining hay with a maximum nutritive value except under absolutely ideal weather conditions. Ensilage of crops by the natural fermentation process may give poor results unless the sugar content is fairly high. The molasses method is simple and probably the most economical in most parts of the country. Many crops give a larger tonnage of silage and dry matter per acre than corn, namely, alfalfa, timothy hay heavily fertilized with nitrogenous manures and rye, and do so at greatly

reduced cost. Attention is drawn to the need for new machinery to deal with the drying of crops such as young succulent grass and cereals.

HELLBERG, A. Foderärternas avkastning i grönt och moget tillstånd. [**The yield of fodder peas in the green and ripe condition.**] *Lantm. Svenskt Land* 26. 781-2. 1942. **544**

A much higher yield in food units and digestible protein is obtained by ensiling than with hay curing.

HEWITT, A. C. T. **Grass hay conservation.** *J. Dep. Agric. Vict.* 43. 331-2. 1945. **545**

One of the deciding factors in the adoption of a method for conserving fodder is availability of labour. The labour requirements for making loose grass hay, baled hay, or silage are stated.

HEWITT, A. C. T. **Hay and silage making. The coming harvest.** *J. Dep. Agric. Vict.* 43. 365-71. 1945. **546**

With instructions for conserving fodder are included descriptions of machinery, methods and costs of harvesting, size of stacks and pits. Silage is more easily conserved than hay under poor weather conditions, but 3 to 4 tons of silage are required to supply the same nutrients as 1 ton of hay, as shown in a comparative table.

HODGSON, R. E., SHEPHERD, J. B., SCHOENLEBER, L. G., TYSDAL, H. M., and HOSTERMAN, W. H. **Progress report on comparing the efficiency of three methods of harvesting and preserving forage crops.** *Agric. Engng, St. Joseph, Mich.* 27. 219-22. 1946. **547**

The three methods, silage making, barn curing, and field curing were compared for losses of dry matter and nutrients during harvesting and storage; changes in chemical composition and in carotene; colour and leafiness of the forage; and labour and machinery requirements. Experiments on the effect of these roughages on milk production and animal health are proceeding.

"Harvesting and storing the forage as silage preserved for feeding slightly more dry matter and protein per acre and materially more of the carotene in the original crop at very little if any greater outlay in hours of labour or machinery in putting up the crop. Only feeding experiments now in progress can determine whether or not one type of forage is more desirable as a feed than another."

JARL, F. Näringsförlusternas storlek vid konservering av vallgrönfoder. [**The extent of nutrient losses in conservation of green fodder from leys.**] *Svenska Vall- o. MosskFören. Kvartalsskr.* 5. 368-79. 1943. **548**

A brief account is given of the losses during conservation by frame drying and ensiling (primarily according to the AIV method) under various conditions, and the investigations conducted in different countries are reviewed. For conservation of surplus aftermath yield from the hay leys, ensiling by the AIV method is most suitable.

In the conservation of the first cut from the hay leys the question is more complicated. When cutting is carried out at the beginning of flowering of the clover as good a yield is anticipated from frame-drying as from the preparation of AIV fodder. The hay crop may, however, be so damaged during prolonged periods of wet weather that the value of the hay becomes low, and the losses in conservation may be great ; decidedly greater than with the preparation of AIV fodder.

To convert the whole of the first cut into AIV fodder would not be possible in practice, when large areas must be cut during a few days. In practice a certain part of the first cut should be taken fairly early, and at latest when the clover is in the bud stage, and converted into AIV fodder, while the remainder should be cured as hay, when cutting should take place at latest at the beginning of flowering.

KELLY, H. J. **Silage vs. hay in seasons of heavy growth.** *Agric. Gaz. N.S.W.* 34. p. 668. 1923. **549**

KIRSCH, W., and JANTZON, H. Vergleichende Feststellungen über die Leistung verschiedener Werbungsverfahren (Darre, Dunndrahtreuter, Dreibockreuter, Trocknung am Erdboden, Gärfutterbereitung) für die Erhaltung der Nährstoffe in einem Kleegrasgemisch. [**Comparison of different means of conserving the nutrients of a clover/grass mixture (tray drier, thin wire frame, tripod frame, ground drying, ensilage.**)] *Biederm. Zbl. B. Tierernähr.* 14. 71-84. 1942. [Tierzucht-Inst. Univ. Königsberg] **550**

The first communication is presented. Clover/grass (50 per cent *Trifolium pratense*, 50 per cent grasses, principally *Phleum pratense*) was cut when the clover was beginning to flower and conserved by the various means enumerated in the title. Yields and losses of nutrients were determined by weighing in the field, analysis of nutrients, and digestibility trials with sheep. The percentage loss of dry matter incurred was as follows : artificial drying 0.6 ; thin wire (Swedish) frames 7.6 ; tripod frames 8.9 ; drying on the ground 9.6 ; ensiled (chopped and with the addition of a formic acid preparation) 4. The low figures in the case of the ground and frame-dried hay are attributable to the unusually good weather and to the short time the frames were in use. The figures obtained through the digestibility trials are as follows, taking the yields of dry matter,

digestible crude protein and starch equivalents from artificial drying as 100 :

	Dry matter	Digestible crude protein	Starch equivalents
Thin wire (Swedish) frame ..	93.0	94.2	93.4
Tripod frames ..	91.6	92.8	97.1
Drying on the ground ..	91.0	88.6	97.9
Silage	96.6	99.1	108.0

KIRSCH, W., and SCHNEPF, F. Weitere Untersuchungen über den Einfluss verschiedener Werbungsmethoden auf die Nährstofferträge bei Rotklee mit besonderer Berücksichtigung des Dünndrahtreuters. [**Further studies of the effect of different methods of conservation upon the yield of nutrients in Trifolium pratense, with special reference to the thin wire drying fence.**] *Jb. Erfahr. Weidew.* 13. 62-81. 1938. [Tierzucht-Inst. Univ. Königsberg, Prussia] **551**

In continuation of previous work at the Institute a red clover/timothy mixture was (a) dried by spreading on sheets on a floor, all mechanical loss being eliminated; (b) made into hay by the usual ground-drying method; (c) dried on tripods and thin wire fences respectively; and (d) ensiled. The content of digestible nutrients was determined by means of feeding trials with sheep. Ensilage gave the highest yield of dry matter and starch equivalents, floor-drying the highest protein yield, but the wire fence drying gave nearly as good results as the floor-drying; the retention of nutrients was slightly better with the five-wire fence than with the four-wire fence. Losses on the tripod were relatively high and mould was formed on some tripods. Drying on the ground was accompanied by very great losses in nutrients, much increased through a relatively slight amount of watering.

MARRYATT, E. R. **Winter feeding of dairy cows.** *N. Z. J. Agric.* 72. 377-9. 1946. [Whakatane] **552**

The feeding values of permanent-pasture hay, temporary-pasture hay, lucerne hay, silage, roots, green cereals and concentrates are considered, with special reference to maintaining a suitable nutritive ratio in winter.

NEW YORK STATE COLLEGE OF AGRICULTURE. Cornell Extens. Bull. 580. War Emer. Bull. 83. **Growing corn for silage and grain.** By *S. R. Aldrich.* 1943. pp. 4. **553**

Owing to the fact that the labour required to cut, shock and husk corn for grain is more than twice that for putting it into the silo, corn should not be grown for grain, but ensiled. Moreover, when preservatives are not available, silage made from corn is more dependable than silage from other crops. There is advice on choice of varieties for silage and for grain, seed-bed preparation, date and rate of planting, fertilizing and manuring, cultivation and cover crops, and harvesting for silage and for grain.

OELESEN, N. A. I. **Experiments on curing hay and ensiling.** Beret. Forsogslab. K. Vet. og Landbohojskoles (Denmark) 172. pp. 149. 1937. **554**

OLDERSHAW, A. W. **Good silage versus bad hay.** *J. Minist. Agric.* 38. 126-9. 1931-2. **555**

OLSEN, F. Om Høberedning og Ensilering af Lucerne. [**Hay curing and ensiling of lucerne.**] *Ugeskr. Landm.* 81. 376-8. 1936. **556**

The AIV method is considered the most suitable. The lucerne must be cut in a slightly earlier stage of development than for hay curing, and the crop must be fresh and succulent. As lucerne does not retain the acid in the uppermost layers of the fodder as well as other green crops, it is best to distribute the acid in such a way that a slightly larger amount is used for the fodder in the upper than in the lower part of the silo. It is advisable to harvest as hay either the first cut or the second cut after an early first cut and ensile the remaining portion of the crop.

REEVES, M. L. M. **Some economic features of silage-making.** *J. Minist. Agric.* 49. 179-81. 1942. [Agric. Advisory Dept., Univ. Manchester] **557**

There is information on the cost of nutrients in silage from the following crops: (1) oats, peas, beans; (2) seeds mixture first crop (3) seeds mixture aftermath; and (4) permanent grass aftermath.

SHEPHERD, J. B., HODGSON, R. E., and SWEETMAN, W. J. **The comparative feeding value of wilted alfalfa silage and alfalfa hay for dairy cows.** *J. Dairy Sci.* 29. 551-2. 1946. [Agric. Res. Admin. U.S.D.A.] **558**

STREET, A. G. **Silage and hay.** *J. Minist. Agric.* 53. 145-7. 1946. **559**

In the climate of Britain, the best policy for the majority of farmers is to secure their summer growth of green stuff for winter fodder as both silage *and* hay. Measures necessary for the success of this procedure are outlined.

SVOBODA, F. Konservace píce. [**Fodder conservation.**] *Časové Otáz. Zeměd.* 1936. No. 56. 1-145. [German summary, 139-45.] **560**

This publication contains 13 lectures presented at meetings of the Czechoslovakian Academy of Agriculture on February 6th and 7th, 1936. The import of foreign concentrates was reduced from about 40,000 carloads in 1934 to 20,000 in 1935. By the usual method of drying forage on the ground 2/5 of the starch equivalents and 1/3 of the protein are lost. Drying on stands should therefore be generally introduced and the artificial drying of clovers studied further. For the preparation of ensilage, pits with air-tight covers of the "Moravia" type are recommended. Subsidies should be distributed for their building. Courses, popular lectures and contests should be arranged in co-operation with the agricultural experiment stations.

VERMONT Agricultural Experiment Station. Bull. 430. **Digestibility of alfalfa, timothy and soybeans as silages and as hays.** By *J. A. Newlander, H. B. Ellenberger, O. M. Camburn* and *C. H. Jones.* 1948. pp. 24. **561**

On a dry matter basis most of the hays carried less ether extract and ash than the silages and more nitrogen-free extract. The artificially-dried hays contained less fibre than the silages and sun-cured hays. The digestion coefficients of the hays, especially those which were artificially-dried, were slightly higher in N-free extract, but significantly lower in ether extract, especially in the case of the sun-cured hay. Crude fibre and N-free extract seemed slightly more digestible in the silages to which molasses were added than in those not so treated. On a dry-matter basis the silages carried slightly more digestible protein than did the hays. The artificially-dried hays carried the most total digestible nutrients, followed in order by the molasses silages, the silages without molasses treatment and the sun-cured hays, the latter two being about equal.

VERMONT Agricultural Experiment Station. Bull. 459. **The conservation of alfalfa, timothy and soybean nutrients as silages and as hays.** By *J. A. Newlander, H. B. Ellenberger, O. M. Camburn* and *C. H. Jones.* 1940. 42. **562**

A comparison was made of the dry matter content, digestibility and palatability, of *Medicago sativa, Phleum pratense* and *Glycine soja* ensiled with and without added preservatives, including molasses, phosphoric acid and AIV acid. Portions of the same lots of timothy and alfalfa were also made into sun-cured and artificially-dried hay.

VERMONT Agricultural Experiment Station. Bull. 494. **The conservation of alfalfa, red clover, and timothy nutrients as silages and**

as hays. II. By *O. M. Camburn, H. B. Ellenberger, C. H. Jones* and *G. C. Crooks*. 1942. **563**

VERMONT Agricultural Experiment Station. Bull. 509. **The conservation of alfalfa and timothy nutrients as silages and hays. III.** By *O. M. Camburn, H. B. Ellenberger, C. H. Jones* and *G. C. Crooks*. 1944. pp. 32. **564**

The effectiveness of sun-curing, artificial drying and ensiling with and without preservatives was compared for each crop. Tables show that sun-cured *Medicago sativa* and *Phleum pratense* hays lost less N-free extract, crude protein, crude fibre, and dry matter than the silages, but ether-extract loss was greater in the hays. Artificial drying prevented dry matter loss, and this was lessened for sun-cured hay by early cutting. Artificially-dried hays are superior in total digestible nutrients to sun-cured hays. In general, alfalfa and early cut timothy hays exceeded silages in nutrient content.

Different preservatives had little effect on the final nutrients recovered from silages and hays, although the value of additional molasses was not depreciated during ensiling. Artificial drying of hay proved the most economical method of conserving the digestible nutrients of the feed, but sun-curing can be efficient under ideal weather conditions. Carotene content was determined for each forage crop when mown, during preservation, and after storage. Hays, particularly those sun-cured and stored for longer than one year, lost high percentages of their original carotene content.

VIRGINIA Agricultural Experiment Station. Bull. 301. **Wet feeds versus dry feeds for milk production.** By *A. D. Pratt*. 1936. 10. **565**

The bulletin discusses the relative merits of feeding dried beet pulp and dried maize silage to dairy cows as compared with the same feeds in a wet condition. Dried silage is as efficient for milk production as moist silage. A relatively high yield of nutrients from the land used for the maize crop may be secured by following the maize with rye, crimson clover or vetch as a winter cover crop and for use as pasture.

WATSON, S. J. **Grass conservation, and its relation to grassland management and animal nutrition.** *Rep. 3rd Grassl. Conf. Zürich*. 1934. pp. 383-98. [German summary, 397-8.] [I.C.I., Jealott's Hill, Bracknell, England] **566**

WATSON, S. J. **Conservation of forage crops on the farm.** *Pap. 3rd Oxford Fmg Conf*. 1938. pp. 109-16. [Discussion, 125-32.] [Jealott's Hill Res. Sta., Bracknell, Berks.] **567**

A consideration of relative nutritive values of hay, artificially dried crops and silage.

WATSON, S. J. **Ensilage and grass drying.** *Scot. J. Agric.* 23. 16-23. 1940. [I.C.I., Jealott's Hill Res. Sta.] **568**

Measures to be adopted in order to obtain maximum returns from grass drying are considered. With present-day driers, the process is economic only for large farms or on areas such as aerodromes. The relative merits of silages made from arable crops and from grassland herbage are noted, together with the merits of the AIV and molasses processes.

WATSON, S. J. **Feeding values of hay, dried grass, and silage.** *Scot. Agric.* 27. 226-33. 1948. [Edinburgh and E. of Scotland Agric. Coll.] **569**

Stage of growth is the clue to a simple classification of all grassland products and composition is closely related to the ratio of leaf and stem. A table is given showing the composition of leaf and stem of Italian ryegrass in which it is noted that the leaf is much richer in protein than the stem at both stages of growth and that the values fall with age. As the plant matures so does the proportion of stem to leaf increase and this will still further reduce the protein content of the whole plant. The changes are typical of those which take place in all plants, grasses and legumes, and afford a simple method of classification by eye.

Hay, while a valuable source of protein, is suitable primarily for the maintenance of farm live stock and is notably deficient in vitamin value though the original crops are good sources of vitamins. Artificial drying and ensilage give a material of high protein content if made from a crop cut at the correct stage of growth, and retain the vitamin value in a large degree. Tables give the nutritive value of hay, of artificially dried crops, and silage.

WIEGNER, G. Welche Nährstofferträge liefern vergleichsweise die verschiedenen Futtergewinnungsverfahren? [**The various methods of fodder production, and a comparison of the amount of nutriment obtained by them.**] *Schweiz. Landw. Mhft. Zürich.* 1932. pp. 26. **570**

A comparison of drying hay on the ground and on hurdles with ensilage and grazing.

WIEGNER, G. Heubereitung und Silage. [**Haymaking and ensilage.**] *Rep. 3rd. Grassl. Conf. Zürich.* 1934. 320-83. [English summary, 381-3.] **571**

The subject is treated from the point of view of the agricultural chemist, and the questions of alteration and loss in nutritive value therefore receive primary consideration. The author deals with the losses incurred, from the time of mowing to the time of employing

the prepared fodder, in the case of (a) haymaking, whereby the respective values of drying on the ground and on frames are compared; (b) ensilage of herbage by the cold and warm fermentation processes; and (c) ensilage by the AIV and related processes. The observations are based on a large number of experiments conducted in Switzerland and in other countries.

WOODMAN, H. E. **Grass conservation.** *J. Minist. Agric.* 54. 501-4. 1948. [School of Agric., Cambridge] **572**

A review of grass drying, grass silage-making and haymaking. The main nutritional finding is re-emphasized, namely, that when grass is cut in its young and leafy stage of growth and dried artificially the resultant product is rich in protein and has a concentrate value. If the drier is always dealing with grass of this character, dried young grass will contain *at least* 16 per cent of crude (i.e. total) protein, and at certain times of the season the figure will be very much higher. A good grade of dried young grass, assuming a moisture content of 10 per cent, will contain from 60 to 63 per cent of starch equivalent, including from 12 to 15 per cent of digestible protein. It is suggested that the producer, when deciding on his system of cutting, should concentrate on protein and starch equivalent, rather than on carotene. Grass meal in the rations of sheep, cattle, pigs and poultry is also discussed.

Grass silage-making cannot be achieved without the sacrifice of considerable quantities of valuable food nutrient, it being estimated that the normal losses from fermentation and juice drainage being about one-fifth of the total nutrients originally present in the herbage. Artificial drying obviates such losses. It is stressed that grass drying and grass ensiling must not be regarded as competitive processes but should be complementary phases of the general problem of grass conservation, especially during the flush period of growth.

18 lb. of good meadow hay is able to supply all the starch equivalent, namely, 6.5 to 7 lb. needed for the maintenance of an average dairy cow. The advisability of farmers' starting cutting some 10 to 14 days earlier than the date on which they customarily commence operations so as to have grass crops that still contain a good proportion of tender leafy herbage is stressed. Air drying of the herbage in carefully made cocks if the weather is settled, or on tripods when the outlook is uncertain, will provide the right conditions for effective curing with the minimum losses of colour and nutritive value.

WYK, N. J. van. **Cowpeas and soybeans as fodder crops.** *Emg S. Afr.* 10. 444. 1935. [Extension Officer, Standerton] **573**

The cultivation of *Vigna* and *Glycine* is recommended for the high veld to remedy protein deficiency in stock feed. Varieties of

cowpeas which thrive on many soils in the high veld are Victor, Iron and New Era, and of soybeans, Yellow 1. The possibilities of haymaking and ensilage are discussed.

WYLIE, C. E., and NEEL, L. R. **Silage versus pasture as winter feed for dairy cows.** Tennessee Agric. Exp. Sta. Report 1941. pp. 29-31. 1942. [Knoxville, Tenn.] **574**

During four winter feeding periods three groups of Jersey cows were fed alfalfa hay *ad libitum* and concentrates at the rate of 1 lb. to 3 lb. of milk. In addition one group received 30 lb. of sorghum-corn silage per cow per day, the second group was allowed out on winter pasture, weather permitting, and the third group had winter pasture, plus permanent pasture on days when the ground was too wet for the animals to be out on winter pasture. Average productions were 2,530, 2,622, and 2,827 lb. of milk and 153, 152 and 166 lb. of fat per cow per 150-day winter feeding period, in the above order. [D. S. A.]

I. CHEMICAL AND MICROBIOLOGICAL ASPECTS

AGRICULTURAL GAZETTE OF NEW SOUTH WALES. **Chemical composition of silage.** *Agric. Gaz. N. S. W.* 51. 457. 1940. **575**

Data are given for moisture, ash, crude fibre, fat, crude protein, carbohydrates and Ca and P in the ash of the following silages: Sudan grass, sorghum, maize, maize and velvet bean, maize and soybean, mixed silage, grass, paspalum and lucerne. [N. A. and R.]

ALLEN, L. A., and HARRISON, J. **The characters of some coliform bacteria isolated from grass and grass silage.** *Ann. appl. Biol.* 23. 538-45. 1936. [Dept. Agric. Bact., Univ. Reading] **576**

Samples of spring grass were obtained from different areas which had not been grazed for varying periods. The characters of the predominant species of coliform bacteria present in fresh grass samples and in silage at different stages of fermentation are determined.

ALLEN, L. A., and HARRISON, J. **A comparative study of lactobacilli from grass silage and other sources.** *Ann. appl. Biol.* 23. 546-57. 1936. [Dept. Agric. Bact., Univ. Reading] **577**

ALLEN, L. A., HARRISON, J., WATSON, S. J., and FERGUSON, W. S. **A study of the chemical and bacteriological changes occurring in grass silage.** *J. agric. Sci.* 27. 271-93. 1937. **578**

The results of small scale laboratory experiments and of experiments in small concrete silos are recorded. Coliform bacteria and lactobacilli appear to form the main bulk of the flora characteristic of fresh grass and are mainly responsible for the formation of lactic and acetic acids in the silage. The coliforms grow in the silage only during the early stages before the temperature of the mass has risen, but the lactobacilli, which increase considerably in numbers in the early stages, are not inhibited by the rising temperature. Obligate anaerobes are present in fresh grass only in very small numbers and do not begin to develop until conditions have become suitably anaerobic and the extent of their proliferation depends upon the availability of residual carbohydrate and protein and the effect on pH.

Production of good silage appears to depend on the early conversion of the available carbohydrate to lactic acid so that the obligate anaerobes find supplies of carbohydrate restricted and the pH unfavourable for development. [N. A. and R.]

ALLEN, L. A., and WATSON, S. J. **Effect of adding whey on the chemical and bacteriological composition of silage.** *Le Lait.* 14. 889-95. 1934. **579**

ALLEN, L. A., WATSON, S. J., and FERGUSON, W. S. **The effect of the addition of various materials and bacterial cultures to grass silage at the time of making on the subsequent bacterial and chemical changes.** *J. agric. Sci.* 27. 294-308. 1937. **580**

In small concrete silos the effect of adding (1) dried whey inoculated with lactobacilli, (2) a solution of dried whey inoculated with lactobacilli, (3) a solution of dried whey alone, (4) fresh whey inoculated with lactobacilli, (5) mineral acid and (6) a solution of molasses inoculated with lactobacilli, on the yield, chemical composition, digestibility and bacterial changes of grass silage was investigated. All 6 samples of silage were classed as excellent and were readily eaten by sheep and cattle and the feeding value of all the samples was similar to that of the fresh grass. The addition of whey or molasses resulted in a material high in lactic acid. Losses of nutritive value were similar in all the silages where free drainage existed. The addition of carbohydrates in an available form coupled in some cases with an inoculum of lactobacilli resulted in the growth of larger numbers of lactobacilli than occurred in untreated silage, and these were of a different character. This gave a greater development of lactic acid and a lower pH value than that normally observed. Streptococci did not attain more than negligible numbers and appear to play no part in the ripening of grass silage. The results obtained with the fresh whey indicated a possible danger of adding too large a quantity of fluid containing, in addition to a large amount of available carbohydrate, a very varied flora which can utilize it. The addition of soluble carbohydrate to grass in ensiling appears to be beneficial but care must be taken to avoid the simultaneous addition of a large mixed flora. Molasses is a suitable source of such carbohydrate and the subsequent development of lactobacilli may be further ensured by inoculating the molasses with a mixed culture of lactobacilli of the *Streptobacterium plantarum* type. [N. A. and R.]

BARKER, A. S. **The valuation of silage.** *J. Minist. Agric.* 48. 303-6. 1942. **581**

Food values, expressed as percentage dry matter, digestible crude protein, and starch equivalents, are recorded for silage made from young grass, mature grass, young lucerne or clover, oat/vetch mixture, maize, etc., and of silage types classified as of high, medium and low protein content.

BENDER, C. B., BOSSHARDT, D. K., and GARRETT, O. F. **Some chemical changes occurring in molasses grass silage.** *J. Dairy Sci.* 24. 147-51. 1941. [New Jersey Agric. Expt. Sta., New Brunswick] **582**

BERESOWSKIJ, A. Chimitscheskol konserwirowanie sotschnych-kormow. [**Chemical conservation of green fodder.**] *Forschungsdienst.* 4. 258R. 1937. **583**

A comparison was made of silage made without addition of chemicals with silage made by Subrilin's method, in which the pH of the silage is reduced to between 3.5 and 4.0 by adding 3 to 5 parts by weight of water containing 5.6 per cent of HCl and 2.4 per cent Na_2SO_4. The ordinary silage lost 7.44 per cent of its dry weight and 18.86 per cent of its protein while the loss of dry matter from Subrilin's silage was only .389 per cent and no protein was lost. [N. A. and R.]

VAN BEYNUM, J. [**Fodder ensilage.**] *Chem. Weekblad.* 34. 432-3. 1937. **584**

Silage is stable when the lactic acid fermentation of sugars produces a pH less than 4.2. Should it not reach this value propionic acid fermentation is liable to occur at a progressively increasing rate due to a further decrease in pH. Treatment with inorganic acids is not always successful on account of the difficulty of ensuring adequate distribution throughout the mass. [N. A. and R.]

VAN BEYNUM, J., and PETTE, J. W. **Butyric and lactic acid fermentation in ensilage.** *Zbl. Bakt.II.* Abt., 94. 413-33. 1936. **585**

BOLTON, W., and COMMON, R. H. **Carotinoids of grass silage.** *Nature, Lond.* 148. 373. 1941. [Chem. Res. Divn., Min. Agric. for N. Ireland, Queen's Univ, Belfast] **586**

When using Moon's method for the estimation of "crude carotene" in routine silage samples (*Herb. Abstr.* 9. Abs. 708. 1939), Moore's chromatographic technique (*Ind. Engng. Chem.* 12. 726. 1940) for removing other chromogens from the carotene solution has been applied to obtain a value for pure carotene. A feature of the chromatograms of a series of grassland silage samples is noted in its probable bearing on the production of "grass-yolks" in eggs from hens fed on silage.

BOLTON, W., and COMMON, R. H. **Modification of Moon's method for the estimation of carotene in silage.** *J. Soc. Chem. Ind.* 61. 50-1. 1942. **587**

When estimating carotene in herbage and silage it is important that a correct estimation be obtained because of the relationship of carotenoids to vitamin A. Some workers found that the crude carotene content of silage was higher than that of fresh material. The discrepancy was traced to the formation of new pigments formed by the action of acid on xanthophyll which were epiphasic in the Willstätter phase separation (used by Moon) and therefore gave values for carotene in excess of the actual value. Since these new pigments have no pro-vitamin A potency their inclusion in the value for carotene in silage is undesirable. It is suggested that in the case of silages the phase separation should be replaced by chromatographic removal of the non-carotene pigments, including xanthophyll, on dicalcium phosphate, as described by Moore. A modification of Moon's method is described.

BORZHKOVSSKIJ, S. E., and KOLOMIJTSCHENKO, M. A. [**Chemical composition of ensilages prepared in various ways. 1. Organic acid and sugar contents.**]
MICHAJKOVA, W. W., and GUTNITZKAJA, P. M. [**2. Dynamics of nitrogenous substances with different methods of ensilage.**] *Ukrain. Biochem. J.* 13. 373-87 and 389-403. 1939. **588**

1. Trials were made in the ensiling of clover in full bloom and of winter vetches beginning to bloom and a comparison was made of 4 methods ; ordinary ensiling, ensiling with a mixture of HCl and Glauber's salt, the addition of brewer's yeast with and without salt, and a culture of lactic acid bacteria. The results indicated that silage prepared by the addition of chemicals, at the high level of 10 to 11 per cent was unsatisfactory for animals and that this method of preservation was ineffective with clover. The product contained appreciable quantities of fixed and free butyric acid and relatively large amounts of lactic acid.

2. With both the ordinary method of preservation and the use of acid preservative, there was considerable decomposition of the protein of these leguminous crops. Acid preservation did not yield optimum results under the conditions of high moisture content and buffering action of the green mass and the introduction of lactic acid bacteria did not give the expected results. The use of brewer's yeast gave the lowest production of ammonia N with the clover but not with the vetches and it is suggested that, under these conditions, with the clover silage there was resyntheses of more complex N compounds from the ammonia. [N. A. and R.]

BROUWER, E. **Influence of mineral acid silage on the acid-base equilibrium.** *Biederm. Zbl. B. Tierernähr.* 7. 1.-35. 1935. **589**

Varying quantities of acid silage, prepared with different amounts of acid, were fed to dairy cows and the effect on the pH and

NH_3 content of the urine and the pH and alkali reserve of the blood plasma determined. Large amounts of acid silage (pH 3-4) or smaller amounts of more acid silage produced a fall in the pH and alkali reserve of the blood plasma and a rise in its chlorine content. The urine became acid and there was a rise in the NH_3 content. In some cases these symptoms were accompanied by a fall in appetite and a staring coat. The addition of sodium bicarbonate to the silage appears to be more effective than that of chalk in preventing these symptoms and a mixture of these two is recommended for normal practice. [N. A. and R.]

BROUWER, E. Onderzoek van een aantal silagemonsters uit de praktijk, bereid onder toevoeging van zuivelafvalproducten of van suiker. [**Study of samples of silage made with dairy products or sugar.**] *Vereeniging Exploit. Proefzuivelboerderij te Hoorn, Ann. Rep.* 1936. 39-102. **590**

Silage with a pH above 4.5 is regarded as unsatisfactory, between 4.0 and 4.5 as doubtful and below 4.0 as almost always satisfactory. Above pH 4.0 NH_3 and butyric acid contents increase rapidly with pH, and NH_3 content is an index of protein degradation and loss. Silage from concrete silos was not usually better than that from pits although the losses due to spoilage were less. Of 121 samples of silage (86 of grass silage) made with additions of 3 to 10 per cent whey, only 6 per cent had a pH below 4.0. Of 19 samples made with 0.5 per cent sugar, only 4 had a pH below 4.0 and 9 had a pH above 4.5. For the same final pH the NH_3 content was about the same but the butyric acid content was higher in samples made with sugar than in those made with whey. [N. A. and R.]

BURNS, A. C., and SMITH, J. **Silage composition.** *Analyst* 67. 328-9. 1942. [Dept. Chem., Midland Agric. Coll.] **591**

Data are given for 12 types of silage, including that made from green cereals and from potato haulms. The minimum, maximum and average values for protein equivalent, starch equivalent, dry matter and protein in dry matter are given as well as the average values for general composition. The protein equivalents are calculated as equal to half the percentage of crude protein and the starch equivalent as equal to the percentage of soluble carbohydrate. Values are given for silage made on a small scale from lawn clippings and also for dried lawn clippings such as might be made by those keeping hens or rabbits.—[N. A. and R.]

COMMON, R. H., and BOLTON, W. **Electrode potentials in laboratory silage.** *J. agric. Sci.* 32. 338-48. 1942. [Ministry of Agric. N. Ireland and Queen's Univ., Belfast] **592**

The average electrode potentials of laboratory silages of various types have been measured. The electrode potentials of ordinary and molassed silages tended to assume values of the order of—0.05 to 0.10 V. from about the third day ; the pH of these silages lay in the range pH 4.0 to 5.5.

In a number of instances secondary increases of electrode potential were observed, frequently in association with secondary deterioration.

The electrode potential of silage prepared with hydrochloric acid and of pH 3.4 remained steady round +0.18 V. ; the potential of silage prepared with formic acid and of pH 3.9 was about +0.35 V. initially but declined toward +0.23 V. at 35 days.

Curves for the ' pure ' carotene content of laboratory silages displayed minima during the early stages of fermentation except in the case of formic acid silage.

COOP, I. E., SEARS, P. D., THURSTON, W. G., and SILL, F. B. **The quality of stack silage in the 1939-40 season.** *N.Z. J. Sci. Tech.* 23. 121A-5A. 1941. **593**

If the material ensiled is too mature, a silage of low protein content and poor feeding value results. Poor quality silage is also obtained by the use of herbage from low-fertility pastures. Analyses of samples obtained from three districts in New Zealand are presented in tabular form.

CORNELL UNIVERSITY Agricultural Experiment Station. Mem. 271. **Destruction of certain vitamins and pigments by nitrous acid.** By *J. K. Wilson.* 1945. pp. 6. **594**

Nitrites in acid solution destroyed chlorophyll, carotene, xanthophyll and ascorbic acid. These easily oxidizable substances are present in crops. When harvested and ensiled, nitrous acid may appear and oxidize these pigments and vitamins.

CRASEMANN, E. La teneur des fourrages volumineux en matières minérales et son importance pour l'alimentation des animaux de rente, les conditions propres à la Suisse étant particulièrement prises en considération. [**Mineral contents of bulky fodder. Importance in the feeding of stock with special reference to Swiss conditions.**] *Rapport spécial XVIIème Congrès Internat. Agric.* 1937. Sect. 6. 1-9. **595**

The effects of factors (e.g. soil, manure, botanical composition harvesting, preserving) which influence the mineral composition of green and dried fodder and silage are considered and reference is made to diseases which are caused by disturbance of the mineral equilibrium in fodder as well as to the effect of fodder on the mineral composition of milk. [N. A. and R.]

CUNNINGHAM, A., and SMITH, A. M. **The microbiology of silage made by the addition of mineral acids to crops rich in protein. 1. Quantitative chemical and bacteriological data.** *Zbl. Bakt.* 100. 394-408. 1939. [Coll. Agric., Edinburgh] **596**

The crops ensiled were a ryegrass and clover mixture and a mixture of beans, peas and vetches, the unchopped fodder being preserved in wooden silos holding 20 tons or in barrels. The amount of acid added, calculated from a preliminary test, was such as to bring the pH of the mixture to about 3.5. In 2 series samples were taken at intervals from 18 to 25 weeks after ensiling and in the other 2 series from 2 to 14 weeks after ensiling. Under the experimental conditions it was found that the growth of micro-organisms was not completely inhibited. Plate counts showed very wide variation even when the samples were taken close together. The microflora of the silage was entirely different from that of the material ensiled and consisted almost exclusively of true lactic acid bacteria. Streptococci occurred only in samples taken a short time after the crop was ensiled and were never met in silage more than 5 weeks old. For samples with a pH below 4.0 the following percentage ranges were found : acetic acid 0.4 to 2.1 ; amino-N 5 to 21 ; ammonia-N 1.8 to 9.6. The results showed that fodder crops containing over 3 per per cent of N can be successfully preserved by the addition of acid in amounts sufficient to lower the pH to values between 3.0 and 4.0 [N. A. and R.]

CUNNINGHAM, A., and SMITH, A. M. **The microbiology of silage made by the addition of mineral acids to crops rich in protein. 2. The microflora.** *J. Dairy Res.* 11. 243-65. 1940. [Coll. Agric Edinburgh] **597**

DAVIES, W. M., BOTHAM, G. H., and THOMPSON, W. B. **Grass silage. A comparison of the changes involved in the ordinary, molasses and AIV processes.** *J. agric. Sci.* 27. 151-61. 1937. [Harper Adams Agric. Coll., Newport, Shropshire] **598**

General conclusions are reached regarding comparative palatability and keeping quality, composition, digestibility, losses and application to farm practice.

DAVIS, G. K., BECKER, R. B., ARNOLD, P. T. D., COMAR, C. L., and MARSHALL, S. P. **Urea in sorghum silage.** *J. Dairy Sci.* 27. 649. 1944. [Florida A.E.S., Gainesville] **599**

FEEDINGSTUFFS COMMITTEE, ADVISORY CHEMISTS' CONFERENCE. **The average composition of different crop silages.** *J. Minist. Agric.* 54. 305-7. 1947. **600**

A large number of silages were judged for quality by visual inspection in the field and by chemical analysis of samples. Statistical examination showed that the composition of silage from any one crop varied widely and was affected by seasonal and local conditions, fermentation, and stage of growth of ensiled crop. Fermentation was affected by stage of growth, but not by type of silo. It was concluded that for an accurate estimate of silage composition laboratory analysis is necessary, but a guide to the probable feeding value can be obtained from tables based on average crop silage composition. Tables are given from which the probable feeding values of several silages can be estimated by observing fermentation quality and stage of growth. [N. A. and R.]

GNEIST, K., and KLEINERT, H. Untersuchungsmethoden für Milchsäure im Silofutter. [**Methods of determining lactic acid in silage.**] *Forschungsdienst* 4. 172-6. 1937. **601**

The electrometric step titration method of Gneist is recommended as being both rapid and accurate. [N. A. and R.]

GORINI, C. **Modern trends in fodder ensilage.** *Mon. Bull. Agric. Sci. Pract.* 33. 98-109. 1942. **602**

The scope of this paper written from an historical and very personal standpoint, and as justifying the author's theories, may perhaps be shown best by giving the headings and sub-headings. Introduction—silage is a microbic culture. (1) Universality of lactic microbic ensilage—the " asphyxial," chemical and the pasteurized thermophilous system. (2) Inoculation of selected ferments—the lactic ferments of fodders, lactic ferments obtained from milk, ensilage with molasses, and the consequences in connexion with the dairying industry. (3) Summary—In this the author states that the modern trend of ensilage confirms and widens the scope of his microbiological doctrine. In order to overcome certain difficulties in connexion with the production of uniform silage the author suggested the use of selected ferments, but "my initiative has so far given but few results, because my instructions have not been followed concerning the use of special lactic ferments for vegetal sugars and exercising, besides, useful action in the nitrogen exchange, in order to obtain other alimentary advantages from ensiled fodders . . . Studies now being made in various countries, which abandon vain autolytic aspirations and utilize to the full my positive doctrine, open up the prospect of real progress in the ensilage of fodders."

HEGSTED, D. M., QUACKENBUSH, F. W., PETERSON, W. H., BOHSTEDT, G., RUPEL, I. W., and KING, W. A. **A comparison of alfalfa silages prepared by the AIV and molasses method.** *J. Dairy Sci.* 22. 489-500. 1939. [Coll. Agric., Madison, Wisc.] **603**

The authors conclude that molasses alfalfa silage appears to be equal to AIV alfalfa silage, and conditions of farm practice probably make molasses silage more suitable for general use. [D. S. A.]

HELLBERG, A. Bästa AIV-foder av material med relativt hög torrsubstanshalt. Inflytandet av grönmassans torrsubstanshalt vid ensilering av vallfoder. [**Best AIV fodder from material with a relatively high dry matter content. The influence of the dry matter content of the herbage in ensiling ley fodder.**] *Lantm. Svenskt Land* 28. 880-2. 1944. **604**

Silage quality is improved and losses are reduced through increasing the dry matter content of the herbage to 30 to 40 per cent. The silo space also is utilized more fully. Fodder with a lower dry matter content is therefore less suitable for ensiling. On the other hand, the results become poorer if the content exceeds the values specified. Dry and sunny days should be chosen for placing the herbage in the silo : this applies particularly to the ley aftermath late in the autumn, when the dry matter content is lower. Predrying depends on the weather and methods of cutting and collecting the herbage. If the work is not too mechanized, drying is advantageous in reducing fodder weight.

HILDITCH, T. P., and JASPERSON, H. **Milk fats from cows fed on fresh pasture and on ensiled green fodder. 1. Observations on the component fatty acids.** *J. Soc. chem. Ind.* 60. 305-10. 1941. [Univ. Liverpool and Res. Lab. J. Bibby and Sons, Ltd., Liverpool] **605**

HUNTER, C. A. **Bacteriological and chemical studies of different kinds of silage.** *J. agric. Res.* 21. 767-89. 1921. **606**

The results of bacteriological and chemical analyses of various kinds of silage indicate that micro-organisms are the principal agents in the fermentation of silage. It is quite natural to assume that enzymes would play some part in the fermentation, and it was found that enzymes did play a part in the hydrolysis of protein.

The production of acidity appears to be due almost entirely to micro-organisms. Silage treated with 2 per cent chloroform, thus inhibiting growth of bacteria, showed practically no increase in acidity, while silage sterilized and inoculated, which process destroyed plant enzymes, showed an increase in acidity closely resembling that of normal silage. The increase in the number of acid-producing organisms usually was followed by an increase in acidity.

The results of these investigations on the cause of formation of acid in silage agree with those of Lamb, and Hunter and Bushnell previously cited, in that the micro-organisms are found responsible for the production of acid.

Plant enzymes evidently play an important part in the hydrolysis of protein, as is shown by the formation of ammonia after the silage had been treated with 2 per cent chloroform, which inhibits the growth of bacteria. The formation of amino nitrogen in the chloroformed silage resembles that of normal silage. Practically no formation of amino nitrogen was observed in silage sterilized and inoculated. It is concluded that the hydrolysis of protein with formation of amino nitrogen is due principally to the action of plant enzymes. Plant enzymes and micro-organisms are both concerned in the formation of ammonia, the former being the more important.

The formation of ammonia occurred in silage treated with 2 per cent chloroform, which inhibits the growth of bacteria, and in silage sterilized and inoculated; but more ammonia was formed in the chloroformed silage than in that sterilized and inoculated. It will be noted that the increase in acid-producing organisms and the formation of ammonia are very well correlated. It is probable that the acid-producing organisms did attack the proteins, decomposing them with the formation of the ammonia. It has been shown by Bertrand and Weissweiller, Heineman, Hefferan and Hastings, Evans and Hart that the lactic bacilli do have a digestive action on protein. Hart, Flint, and Evans working on the action of certain bacteria in regard to the ripening of cheddar cheese, found that *Bacillus casei* had the ability to produce ammonia. Hunter in an article on alfalfa silage suggests that a small part of the protein hydrolysis may be caused by the ability of acid-producing organisms to utilize protein as a source of energy in the absence of carbohydrates.

The largest number of yeasts were found in the first few days of the fermentation. They increased in number until all the free oxygen was consumed, then decreased. Lamb states that alcohol is formed first by enzymes and later by yeasts. It is more easy to believe alcohol is formed first by yeasts and later by enzymes, because yeasts are present in greater numbers at the beginning of fermentation.

The only difference noted in the fermentation of Canada field pea and oat silage from that of corn silage was in the number of organisms belonging to the bulgaricus group. There were more organisms belonging to this group in corn silage than in silage composed of Canada field peas and oats.

No difference could be noted in the fermentation of corn silage when compared with corn and soybean silage.

HUNTER, O. W. **Bacteriological studies of alfalfa silage.** *J. agric. Res.* 15. 571-92. 1918. **607**

1. Silage made from alfalfa alone is of an inferior quality. By the addition of an available carbohydrate supplement, a good quality of silage may be produced.

2. The microbial flora of the two types of silage, so far as noted, was practically identical.

3. The chemical data demonstrate that alfalfa with a supplement produced a higher acid content than alfalfa alone.

4. Alfalfa silage shows a greater amount of protein decomposition, as evidenced by the amino-nitrogen and ammonia determinations.

5. The decomposition of protein was checked by the addition of a utilizable carbohydrate.

JOHNSON, B. C., ELVEHJEM, C. A., PETERSON, W. H., and FAGEN, H. J. **The preservation of the 'grass juice factor' in silage.** *J. Nutrition.* 18. 527-35. 1939. [Coll. Agric., Univ. Wisconsin, Madison] **608**

It was found possible to preserve the 'grass juice factor' in forages by ensiling. The AIV and phosphoric acid methods of ensiling were found to give better preservation of the 'grass juice factor' than did the molasses method. Milk from cows fed phosphoric acid alfalfa silage was found to be approximately as rich in the 'grass juice factor' as milk produced by cows on summer pasture.

JOSHI, N. V. **A study of the changes in the bacterial flora of different silages.** *Proc. 22nd Indian Sci. Congr.* 1935. p. 355. **609**

Some fodder plants such as *Trifolium alexandrinum* and dhub grass (*Cynodon dactylon*) if ensiled by themselves do not yield a good silage and the addition of wheat or oat straw or molasses improves the product obtained after ensiling. A study of the changes in bacterial population of the different materials during the course of ensilage showed that the organisms of the *Aerogenes-Cloacae* group are predominant in the early stages when *Trifolium alexandrinum*, dhub grass or Kudzu vine are ensiled by themselves, *Streptococcus lactis* appearing only in later stages. When wheat straw, oat straw or molasses are added to these fodders, however, the predominant organism from the start is *Streptococcus lactis*.

JOURNAL OF THE MINISTRY OF AGRICULTURE. **The average composition of different crop silages.** *J. Minist. Agric.* 54. 305-7. 1947. **610**

This is a report prepared by the Feedingstuffs Committee of the Advisory Chemists' Conference.

KANE, E. A., WISEMAN, H. G., HARTMAN, A. H., and CARY, C. A. **Spectrophotometric data bearing on the character of the pigments obtained in routine determinations of carotene in hays, silages and freshly cut plant materials.** *J. Dairy Sci.* 19. 466. 1936. [Bur. Dairy Indust., U.S. Dept. Agric.] **611**

KAUKO, Y., and VÄLKKILÄ, Y. Einige Beobachtungen zur Kenntnis der Grünfutterkonservierung. (Vorläufige Mitteilung.) [**Some observations on green feed conservation. Preliminary communication.**] *Svensk kem. Tidskr.* 50. 214. 1938. **612**

In a previous study (*Kolloid-Ztschr.*, 1938 82, 207) of the physical chemistry of silage, the conditions were not comparable with those obtained in practice. Tests have, therefore, been made with silage in closed containers, connected with a manometer and using the antimony electrode.

The pH of fresh silage is at first about 6 ; addition of 0.1 mol. per kg. of HCl reduces it to about 3 but, on standing, it rises again to 4 with spinach or 5 with clover. When lactic acid is used in equivalent concentration the pH is practically constant at 4 to 4.5.

Silage without acid shows a rise in pH on standing and considerable evolution of gas occurs. Further studies with lactic acid are proposed. [N. A. and R.]

KIRSCH, W. Stand der wissenschaftlichen Arbeiten auf dem Gebiet der Grünfuttereinsäuerung. [**The position of scientific work in the field of green fodder ensilage.**] *Forschungsdienst.* 1. 58-63. 1936. [Univ. Königsberg, Prussia] **613**

KLINC, L. Recherche et dosage de l'acide butyrique dans les ensilages. [**Butyric acid in silage.**] *Biederm. Zbl. B. Tierernähr.* 7. 281-9. 1935. [Nat. Inst. Agron., Paris] **614**

The method previously described (*Biochem. Ztschr.*, 1934, 273, 1) for the estimation of butyric acid has been adapted for use with silage and is detailed. Different silages were found to contain varying amounts of either the normal or the iso-acid, but silages prepared by the AIV method contained, on the average, only 0.005 per cent of the acid. [N. A. and R.]

KŘÍŽENECKÝ, J. Vitaminevá hodnota konservované píce. [**Vitamin content of conserved forage.**] *Časové Otáz. Zeméd.* 1936. No. 56. 93-9. [Section Biol. Inst. Zootechnics, Brno] **615**

Changes in the content of all the important vitamins in forage are discussed according to method of conservation (hay drying, ensilage and artificial drying). Vitamin A is conserved best by artificial drying, then in diffuse light on stands in thick layers and finally by ensilage, if sap is retained. Greatest vitamin A losses occur when hay is dried as usual in the full sunlight. Vitamin B is similarly least affected by artificial drying, more so by drying on stands and most by drying on the ground. Any drying practically destroys vitamin C. Vitamin D is formed mostly under the influence of the sun's rays when hay is dried in full sunshine and in thin layers. Vitamin E is conserved best by artificial, followed by natural drying on stands. Nothing is known about vitamin E changes in ensilage.

LECLERC, S. A. **Losses in making hay and silage.** *Yearb. U.S. Dep. Agric.* 1939. 992-1016. [Food Res. Divn., Bur. Chem. Soils.] **616**

LEPPER, W. Vereinfachung und Abkürzung der Destillationsmethode zur Bestimmung der Gesamtessig- und -buttersäure im Sauerfutter. [**Simple and rapid distillation method of determining total acetic acid and butyric acid in silage.**] *Landw. Vers Sta.* 128. 127-32. 1937. **617**

Two methods are recommended. In the first, to 250 ml. silage extract are added 10 ml. H_2SO_4 (50 per cent by vol.) and the mixture is distilled, two successive 100 ml. portions of distillate being collected without interrupting the distillation. In the second, 5 ml. H_2SO_4 are added to 200 ml. silage extract and the mixture distilled, two successive portions of 100 ml. and 50 ml. respectively of distillate being collected without interruption of the distillation. From the values obtained on titrating these distillates with N/20 alkali the percentages of acetic and butyric acids in the silage can be calculated by formulae given. [N. A. and R.]

MCLEAN, W. **Note on 'The significance of the pH determination in the evaluation of quality in silages.'** *J. agric. Sci.* 31. 518-21. 1941. [Univ. Coll., Bangor] **618**

MCNAB, L. M. **Silage in relation to acidity in milk.** *J. Dep. Agric. Vict.* 17. 633. 1919. **619**

MANN, T. B. **The separation of β-carotene, neo-β-carotene and xanthophyll of dried grass, pasture grass and silage.** *Analyst* 69. 34-9. 1944. [J. Bibby and Sons, Ltd., Neston, Wirral] **620**

Plant material was macerated with sand, and extracted with a 1 to 3 mixture of acetone and ether in a Soxhlet extractor. The extract was evaporated, made up in petrol ether, and passed through a column of extracted bone meal. β-Carotene was estimated by spectroscopic or colorimetric methods in the filtrate. The column was next eluted with ether, and the eluate evaporated, and saponified. The unsaponifiable matter was dissolved in petrol ether and absorbed on a fresh bone ash column. Neo-β-carotene was eluted with benzene, and xanthophylls with acetone. Pseudo-α-carotene, which the author suggests has been confused with neo-β-carotene by Beadle and Zscheile, accompanied β-carotene. Biological tests on an extract of old, dried grass containing pseudo-γ-carotene mixed with β-carotene showed an activity equal to that expected if all the pigment had been β-carotene, and it is concluded that pseudo-x-carotene has biological activity. [N. A. and R.]

MARTIN, J., and REYNTENS, N. Bepaling van organische zuren in kuilvoeder. [**Determination of organic acids in silage.**] *Meded. LandbHoogesch. Gent.* 9. 209-26. [French, German and English, summaries, 225.] 1941. [Govt. Sta. Animal Nutrition, Ghent Belgium] **621**

Four methods of determination were compared for accuracy and rapidity. Total butyric and acetic acids are determined by the Leeper-Flieg method, lactic acid by Gneist's electro-metric method. Free acids could be calculated from the exact pH value and the total acidity.

MIKHIN, A. M. **Industrial (practical) method of evaluating the quality of silage.** *Problemy Zhivotnovodstva* 1935. Nos. 4-5. 145-54. **622**

A quick method is described in which the pH of the silage is taken as an indication of its quality. A portable pH apparatus is described similar to that used for estimating pH in soils. The pH is determined colorimetrically by the use of a special indicator consisting of equal parts of bromthymol blue and methyl red. [N. A. and R.]

MONROE, C. F., HILTON, J. H., HODGSON, R. E., KING, W. A., and KRAUSS, W. E. **The loss of nutrients in hay and meadow crop silage during storage.** *J. Dairy Sci.* 29. 239-56. 1946. **623**

In hay containing less than 30 per cent moisture, the dry matter loss in storage varies between 3.5 to 9.0 per cent ; with more than 30 per cent moisture, dry matter losses vary between 15 and 40 per cent according to temperature. Such hay (30 per cent moisture) is not considered safe for storage, because of the danger of heating which results in spontaneous combustion or browned hay. For a given moisture content chopped hay heats up more than long hay. Mow drying by forced ventilation results in good quality hay.

Dry matter losses due to top spoilage, seepage, and fermentation are given. The type of treatment affects carotene preservation ; treatment with mineral acids has the most favourable effect, and no treatment or wilting of the crop produces least carotene retention. The ensiling process destroys the germinating capacity of several weed seeds.

MORRIS, S., WRIGHT, N. C., and FOWLER, A. B. **The nutritive value of proteins for milk production. IV. A comparison of the proteins of (a) spring and autumn grass, (b) grass conserved as silage (AIV acid treated, molasses treated and ordinary untreated), and (c) grass conserved by drying, with notes on (i) the effect of heat treatment on the nutritive value and (ii) the supplementary relations of food proteins.** *J. Dairy Res.* 7. 97-121. 1936. [The Hannah Dairy Res. Inst., Kirkhill, Ayr] **624**

NEAL, W. M., and BECKER, R. B. **A chemical study of ensiling soybeans.** *J. agric. Res.* 46. 669-73. 1933. [Florida Agric. Exp. Sta.] **625**

The feeding value of *Glycine max* ensilage was investigated to determine silo efficiency. The silo was 10 feet in diameter and 20 feet 10 inches high. It was filled with soybeans cut in early bloom stage, giving about 15 feet of settled silage. Samples were taken as filling progressed and 5 muslin bags, each containing 10 kilogrammes, were placed at various depths. After a minimum of 117 days, the bags were removed at intervals, their contents weighed and 1 kilogramme oven-dried for chemical analysis. Changes in composition in freshly cut soybeans and soybean silage are tabulated, analyses being given for moisture, dry matter, crude protein ether extract, crude fibre, nitrogen-free extract, ash, calcium, magnesium and phosphorus. There was gravitational movement and increase in moisture. A 9 per cent loss of dry matter was largely from protein and nitrogen free extract. A 17 per cent loss of nitrogen-free extract occurred while there was little change in the crude fibre. The greatest loss was in crude protein which amounted to 34 per cent, being greatest at the bottom of the silo. Ether extract increased 20 per cent. All changes are stated as being the "result of the combined action of bacterial fermentation, plant enzymes, chemical interaction and down wash of solutions in the silo."

NELSH, A. C., MCFARLANE, W. D., and BREUHIN, W. A. **A modified procedure for the determination of carotene in silage.** *Canad. J. Res.* [B]. 17. 325-30. 1939. [Fac. Agric., McGill Univ., Macdonald Coll., Quebec] **626**

Acid silage was refluxed with alcoholic potash, extracted with light petroleum, and the xanthophyll removed with 92 per cent ethyl alcohol. The extract in light petroleum was passed through a column of mixed magnesia and siliceous earth. The "X" pigments, which are formed from xanthophyll in acid silage, were adsorbed, but could be eluted with ethyl alcohol; carotene was not adsorbed. The "X" pigments resembled carotene in their $SbCl_3$ reaction, and in the rate at which they were oxidised by benzoyl peroxide, but were more soluble than carotene in many solvents. In the routine estimation of carotene in silage with the Evelyn photoelectric colorimeter, hexane could be used as a solvent for the epiphasic layer, and the interfering "X" pigments could be removed with benzyl alcohol. Accurate results were obtained except when the ratio of "X" pigments to carotene exceeded. [N. A. and R.]

NEW JERSEY Agricultural Experiment Station. Bull. 683. **Effect of ensiling upon the composition of forage crops.** By *M. W. Taylor, C. B. Bender* and *W. C. Russell*. 1940. pp. 19. **627**

Complete feed analyses and carotene estimations were made on over 100 samples each of green crops and the corresponding silages, including a wide range of crops ensiled with and without preservatives. Most of the materials showed losses of from 10 to 15 per cent in total dry matter during ensiling. The loss of protein was usually higher than that of dry matter, and was most marked in samples high in protein. The use of larger amounts of preservative tended to reduce protein losses. Carotene values for the silages were highly variable, but in general good quality silage showed a high degree of preservation of carotene. Grasses and legumes ensiled with molasses or phosphoric acid contained from 2 to 3 times as much carotene as maize silage. The loss of carotene did not necessarily parallel losses of other constituents, but seemed dependent on moisture content and degree of packing. Fat, P and ash also showed great variability. [N. A. and R.]

PAGÉ, E., and MAYNARD, L. A. **Chemical changes in phosphoric acid silage.** *Industr. Engng Chem.* 32. 1140-3. 1940. [Cornell Univ., Ithaca] **628**

A silo was filled with a crop of mixed grasses, clover and alfalfa. The crop was divided into layers by waterproof sheets and a definite amount of 68 per cent phosphoric acid, varying from 0 to 24 lb. per ton of fresh fodder, was added to each layer, the treatments being duplicated in the lower and upper halves of the silo. The silo was filled in June 1938 and the layers taken out and sampled for analysis during February and March 1939. All layers had a good odour and appearance but revealed differences in chemical composition, the quality of the final product, as revealed by the chemical analysis, being influenced by the position of the layer. The amount of lactic acid produced as well as of the phosphoric acid added had a marked effect on the quality of the samples. It would appear that a larger amount of phosphoric acid would be required than of AIV mixture. While phosphoric acid is of definite value as a preservative its action must be supplemented by a strong lactic acid production in order to achieve the best results. The results would suggest that the phosphoric acid treatment may not prove so generally satisfactory as the use of molasses. [N. A. and R.]

PAGE, H. J., and WATSON, S. J. **The present position of silage-making.** *Agric. Progr.* 12. 99-102. 1935. [I.C.I. Agric. Res. Sta., Jealott's Hill, Berks.] **629**

Research in the silage-making process is outlined, with special reference to the reduction of respiration and associated losses, by exclusion of air during filling, and to the stimulation of lactic fermentation.

PARKS, R. Q. **A rapid and simple method for determining moisture in forages and grains.** *J. Amer. Soc. Agron.* 33. 325-35. 1941. [Dept. Agron., Ohio A.E.S.] **630**

A simple method for the rapid estimation of moisture in grasses, silage, small grains, maize and hay, to within 3 per cent of the true moisture content, is described. The sample, cut to about half-inch lengths in the case of grasses or crushed in the case of grains, was mixed with an exact weight of calcium carbide, 2 mol. H_2O reacting to yield 1 mol, of acetylene. The heat generated accelerated the reaction. A simple balance is described from which the percentage moisture could be read directly from the scale. Estimations required only from 10 to 25 minutes to complete. [N. A. and R.]

PENNSYLVANIA Agricultural Experiment Station. Bull. 444. **The fermentation of alfalfa silage.** By *R. W. Stone, S. I. Bechdel, H. D. McAuliffe, F. R. Murdock* and *R. C. Malzahn.* 1943. pp. 17. **631**

Bacteriological and chemical analyses were made of leguminous silages to which phosphoric acid, molasses, salt, commercial inoculum, corn-and-cob meal or wilted alfalfa had been added as preservatives. The number of bacteria rose rapidly during the first few days of fermentation to as much as several hundred million organisms per gram of silage. In each case the organisms belonged to the genus *Lactobacillus* and were evidently plentiful in the normal green plant material used for silage.

Preservation depends on high acidity (pH below 4.2) and exclusion of air. Although pH may be reduced by mineral acids, fermentation resulting in lactic acid formation is preferred for silage. The presence of sufficient fermentable sugar is therefore the chief single factor in preserving silage. It may be added in the form of molasses (80 lb. per ton of forage), corn-and-cob meal (200 lb. per ton of forage) or the amount of sugar in the plant itself (alfalfa) may be increased by wilting.

The influence of moisture on fermentation of silage is less important than the amount of sugar, but preservation is more satisfactory when the moisture content is below 75 per cent. Salt appears to be unimportant as a preservative.

PENNSYLVANIA Agricultural Experiment Station. Bull. 453. **Energy values of a group of silages.** By *E. B. Forbes, R. W. Swift* and *J. W. Bratzler.* 1943. pp. 13. **632**

The method adopted for a group of silages fed to fattening steers was that of the balance of matter and energy, as accomplished by means of the respiration calorimeter. The net energy values were highest in corn silage and decreased in this order : soybean-molasses, clover-timothy-molasses, alfalfa-phosphoric acid + limestone, alfalfa-molasses, soybean-sorghum, alfalfa-phosphoric acid.

PERKINS, A. E. **Dry matter determination in green plant material and in silage.** *J. Dairy Sci.* 26. 545-51. 1943. **633**

The presence of different volatile materials in silage has long been known, but has not been adequately recognized in analyses. This work compares the usual indirect method of water determination by oven drying with a direct method in which the water is recovered by distillation and determined volumetrically. Results by the two methods are in agreement for the silage crops, but not for the silage. The drying, or indirect, method of water determination has resulted in over-estimating the dry matter losses of silage-making and underestimating the feeding value of silage.

PERKINS, A. E., HAYDEN, C. C., MONROE, C. F., KRAUSS, W. E., and WASHBURN, R. G. **The relation of dry matter to quality in meadow crop silage.** *Bi-m. Bull. Ohio agric. Exp. Sta.* Vol. 30. No. 234. pp. 108-14. 1945. **634**

Control of dry matter is of greater importance than addition of preservative, whether molasses or acid, in establishment of silage quality. Dry matter content of the silage can be increased by harvesting the crop when mature and under good weather conditions, by allowing field wilting if crops have to be harvested when moist, and by adding dry material such as ground grains which also improve the silage in other ways. 100 lb. grain per ton of meadow crop increases the silage dry matter 3.5 per cent.

POIJÄRVI, I. Försök med AIV-foder. [**Trials with AIV fodder.**] *Stat. LantbrFörsöksverks. Vet. Publ.* No. 63. 1934. pp. 153. [German summary, 115-7.] **635**

Nutrient losses in trials made with clover, clover-timothy and timothy are recorded. Experiments with vetches, peas, oats and barley resulted in similar losses. Tabulations of digestibility coefficients and food unit values of the most important kinds of AIV fodder are included, and information is supplied on the stage of cutting clover or *Phleum* leys in relation to suitability of the material for the AIV method of conservation. Conserving clover aftermath, green fodder and marrow stem kale is considered from an economic point of view.

POIJÄRVI, I. Kokeita AIV-Rehulla. [**Trials with AIV fodder.**] *Valt. Maatalousk. Julk.* No. 63. pp. 143. [German summary, 113-5] 1934. **636**

In nine experiments with AIV fodder containing clover, clover and timothy, and timothy alone the losses of nutritive compounds were on the average as follows : organic matter 8.8 $\pm$ 0.7 per cent, ash 6.1 per cent, crude protein 6.2 $\pm$ 2.2 per cent, pure protein 27.2 $\pm$ 3.6 per cent, raw fats and N.free extracts 13.9 $\pm$ 1.3 per cent and

raw fibre 0.6 per cent. With marrow stem kale the losses were considerably larger (in one experiment, organic matter 27.1 per cent and crude protein 37.3 per cent).

The chemical composition of common AIV fodders is determined, giving the numbers of analyses. With ten experiments the digestibility of the nutritive compounds in AIV fodders are determined. Starch and fodder units of common AIV fodders are calculated. The balance of mineral in feeding with this fodder becomes deficient regarding bases, but is easily adjusted by a given amount of calcium carbonate. Feeding with AIV fodder has had no influence on the percentage of milk fat. The economic value of the AIV method is compared with other methods under Finnish conditions.

QUACKENBUSH, F. W., STEENBOCK, H., and PETERSON, W. H. **The effects of acids on carotenoids.** *J. Amer. chem. Soc.* 60. 2937-41. 1938. [Dept. Biochem., Coll. Agric., Univ. Wisc.] **637**

In alfalfa silage and acidified fresh alfalfa considerable quantities of 5 carotinoid pigments other than carotene which were not present in untreated alfalfa were found. 3 of the pigments are formed from lutein by the action of acid. The pigments were also found in butter from cows receiving AIV silage. As these substances are estimated as carotene by the usual methods and as 2 of them were tested and shown to have no vitamin A activity, they constitute a source of error in chemical determinations of the carotene (and vitamin A) content of silage and butter. [D. S. A.]

RICHTER, K., and BRÜGGEMANN, H. Untersuchungen über den Futterwert von Gärfutter aus verschiedenen Futterpflanzen. [**Feeding value of silage from various fodder plants.**] *Forschungsdienst* 4. 395-403. 1937. **638**

This is a summary of the results of a large series of experiments, few details of which are given. The plants were ensiled in large containers having air-tight covers and wethers were used in the digestibility tests. Tables are given showing the percentages of organic materials, crude protein, fat, crude fibre and N-free extractives in the dry silage and in the digestible material of the dry silage, the digestibility coefficients of each of these constituents and the starch values of the digestible material for the following: maize cobs, sunflowers, marrow stem kale, potato tops, mixture of common and sand vetch, mixture of crimson clover and meadow grass, mixture of beans and oats, horse beans, red clover, bitter yellow lupins; sweet yellow lupins and soya beans. The dry matter, digestible crude protein and roughage contents and the starch values of 100 kg. of the fresh silages varied as follows: 120 g. (marrow stem kale) to 280 g. (mixture of beans and oats); 9 g. (sunflowers) to 29 g. (horse beans); 29 g. (marrow stem kale) to 109 g. (mixture of beans and

oats); and 5.6 kg. (bitter yellow lupins) to 12.6 kg. (soybeans). [N. A. and R.]

SCHARRER, K., and SCHREIBER, R. Einsäuerungsversuche mit Silomais und Verdauungsversuche mit verschieden hergestelltem Maisgärfutter zu Schafen. [**Experiments on the ensiling of maize. Digestibility of the silage by sheep.**] *Biederm. Zbl. B. Tierernähr.* 12. 46-76. 1940. [Agrik. Chem. Inst., Univ. Giessen] **639**

Maize, cut at a later stage of growth than usual, was ensiled in small concrete and wood silos, with and without additions of acid or sugar. Results were satisfactory in all cases and showed no necessity for the additions. The content of lactic acid was relatively high, of butyric acid low. The pH value was in all cases well below 4.00. On the average of 8 trials the starch equivalent of the silage was 9.5 per cent, or 53.9 per cent on the dry substance. [N. A. and R.]

SCHMALFUSS, H., and WERNER, H. (with ROBINSON, C.) Säurebindung und Eiweissabbau in Gärfutter. 2. [**Fixation of acid and degradation of protein in silage. 2.**] *Z. Tierernähr. Futtermittelk.* 2. 105-9. 1939. [Chem. Staatsinst., Univ. Hamburg] **640**

Peptides, in the amounts in which they occur in silage, are not broken down to amino-acids and hence any changes in buffering effect cannot be attributed to the production of such acids by degradation of peptides. [N. A. and R.]

SILL, F. B., and SEARS, P. D. **Silage studies. III. Changes in chemical composition and losses during ensilage of pasture.** *N.Z. J. Sci. Tech.* 24. 130A-40A. 1942. [Palmerston North] **641**

Preliminary data obtained for chemical composition were similar to those of overseas workers, crude protein, crude fibre, ash and ether extract being higher, and N-free extract lower in the silage. The exceptionally high losses which occurred during ensilage were, however, higher than those recorded in Great Britain and the importance of leaching as a source of loss in small concrete silos open to the weather was demonstrated. Roofing to prevent penetration of rain water considerably reduced this loss. The pH values of the silages were also higher than those considered desirable by overseas workers for the production of good silage.

The addition of molasses at 30 lb. per ton of green material had no effect in altering the chemical composition, lowering the pH, or reducing losses. Analyses of the exudate during the first few days after ensiling showed that it was rich in total nitrogen and ash.

ŠKORPÍK, P. Richtlinien für die Analyse und Bewertung von Gärfutter. [**Guiding principles for the analysis and judgment of**

silage.] *Biederm. Zbl. B. Tierernähr.* 14. 424-35. 1942. [Landwirtsch. Landesforschungsanst., Brünn] **642**

The percentages of lactic, acetic and butyric acids in the total acids and the pH value of the silage are estimated. The quality of the silage is determined from the equation : R.P.=M.P. + E.P. — B.P. — K. where M.P. is the percentage of lactic acid, E.P. is a value determined by a table given from the percentage of acetic acid, B.P. is the percentage of butyric acid and K. is a correction introduced if the pH value lies outside the limits 4.0 to 4.1 K rises from zero by 2 for every 0.1 excess in the pH above 4.1 or by 1 for every 0.1 that it falls below 4.0. Silages showing R.P. values above 46 are considered good and those with values above 76 excellent. [N. A. and R.]

Smith, A. M., and Comrie, A. **The composition of different kinds of silage.** *J. agric. Sci.* 28. 203-11. 1938. [Chem. Dept. Edinburgh and East of Scotland Coll. Agric.] **643**

Summarised data are given showing the pH, percentages of dry matter and crude protein, total acidity, amino-acids, volatile acids and bases and the lactic acid in 8 samples of fresh green crops before ensiling and in 91 samples of different types of silage. The latter are grouped according to the method of ensiling used and the nature of the green crop. The data are discussed in the light of those published by other workers. [N. A. and R.]

Svenska Vall- och Mosskulturföreningens Kvartalsskrift. Maskrosrikt gräs till surfoder. [**Silage from pasture full of dandelions.**] *Svenska Vall- o. MosskFören. Kvartalsskr.* 7. 56. 1945. **644**

An account is quoted from *Norsk Landbruk*, 1945, No. 5/6, of silage made with formic acid from 32,000 kg. of green crop from a 3-year meadow which was yellow with dandelions. There was little clover and the timothy had not shot. The percentage composition of the silage, as sampled in November, was water 78, ash 2.3, protein 3.8, fat 1.4, N-free extract 8.8 and fibre 4.8. Digestible protein was 2.7, fat 0.9 and carbohydrate 8 per cent. A feed unit was reckoned to be 5.6 kg. silage. The low fibre content was remarkable. Cows ate the silage eagerly, the dung was normal, and the milk was of good quality and the fat content rose. [N. A. and R.]

Szonntag, E. Methode für die Untersuchung eingesäuerter Futtermittel. [**Methods of analysis of fodder silage.**] *C. R. Ve Congr. internat. tech. chim. Indust. agric. Scheveningen, Holland* 1. 224-32. 1937. **645**

TAYLOR, M. W. **Carotene and vitamin A in silage.** *N. J. Agric.* 19. No. 5. 2-3. 1937. **646**

TAYLOR, M. W., RUSSELL, W. C., and BENDER, C. B. **A comparison of the vitamin A potency and carotene content of different types of silage.** *J. Dairy Sci.* 22. 591-7. 1939. **647**

A comparison was made between the results obtained by colorimetric estimation of carotene and biological estimation of vitamin A in 9 different silages. Carotene estimations were made on each sample at the beginning, in the middle, and at the end, of the period of the biological test, which was made by the method recommended by the U.S. Pharmacopoeia on groups of 13 to 15 rats. Some loss of carotene during the experimental period of 4 weeks was found for all samples. The concordance of the results was not very satisfactory. [N. A. and R.]

ULVESLI, O. Surfôr av poteter og spinat. Tørrstofftap ved opbevaring av poteter i kjeller. [**Silage from potatoes and spinach. Loss of dry matter in potatoes during storage in cellar.**] *Norges Landbrukshøiskole. Fôringsforsøkene. Beretn.* No. 45. pp. 30. 1938. **648**

Silage of potatoes with and without added acids and of spinach with added acids gave the following percentages losses : dry matter 5, 16 and 20 ; organic matter 4, 16 and 17 ; crude protein 30, 55 and 18 respectively. Trials, in each case on 2 sheep, gave digestibility coefficients for the organic matter of the silage of 88, 83, and 58, respectively. Potato samples kept in wire netting bags in bins for periods ranging from 114 to 220 days showed a mean loss in weight ranging from 6 to 12 per cent. and of dry matter from about 8 to 14 per cent. Little putrefaction was observed in any of the 7 years in which studies were made. [N. A. and R.]

UNDERWOOD, E. J., and CURNOW, D. H. **Vitamin A in the nutrition of sheep in Western Australia. 3. The carotene content of fodders and grains.** *Aust. vet. J.* **20.** 248-53. 1944. [Dept. Agric., Perth, W. Aust.] **649**

Provitamin A content of a series of fodders grown in West Australia, namely, oat, wheat and clover or meadow hays, oat and clover silages, and wheat, barley and oat grain, has been studied. Results, discussed in regard to the capacity of the different feeds to supply vitamin A requirements of stock, are expressed as crude and true carotene. The mean true carotene content of wheat was 0.8, of oats 0.9 and of barley 1.1 p.p.m. on a dry basis. The mean true carotene content of wheaten hay was 2.8 (range 0.5—8.8), oaten hay 5.6 (1.1—13.3), clover or meadow hay 14.3 (2.4—3.3), oaten silage 46 (11—77), and clover silage 144 (124—165) p.p.m. on the dry basis.

URBÁNYI, L. A szilózás befolyása a takarmányok ásványi anyagtartalnára. [**The effect of ensilage upon the mineral content of fodder.**] *Mezögazdasági Kutatás.* 8. 374-6. 1935. **650**

The author presents an analytical review of the relative alterations in the mineral components of silage composed of lucerne and of maize stalks, which increase as a result of the loss of organic substances. The solubility of the mineral substance increased.

VERMONT Agricultural Experiment Station. Bull. 485. **The conservation of nutrients in grass silage. IV.** By *J. A. Newlander, H. B. Ellenberger* and *C. H. Jones.* 1942. pp. 11. **651**

First and second cuttings of timothy and mixed grasses were ensiled, using 2 or 3 per cent molasses as a preservative. The dry matter content ranged from 31 to 36 per cent. The edible portion of these silages was of high quality in appearance, odour, palatability and digestibility. However, the loss of dry matter was high, averaging 24.2 per cent. This was in part due to the small size of the silos. Digestibility determinations of silages, of early and of later cut hays showed that the nutrient content of the silages corresponded closely to that of the early cut hay, June 19.

VIRTANEN, A. I. **The microbiology of ensilage production.** *Zbl. Bakt. II. Abt.* 95. 472-7. 1937. **652**

VIRTANEN, A. I., and KARSTRÖM, H. **The decisive importance of pH in silage problem.** *Extrait des Compt. rend. du Lab. Carlsberg, Ser. Chim.* Vol. 22. p. 528. 1938. **653**

VIRTANEN, A. I., KARSTRÖM, H. and LAINE, T. **Preservation of amino-acids in AIV silage and in ordinary silage.** *Suom. Kem.* 8.B. 6. 1935. **654**

A considerable portion of the NH_3 occurring in ordinary silage is derived from amides. The decomposition of tryptophane by certain organisms, e.g., *B. coli*, is indicated. AIV silage contains notable amounts of tryptophane. [N. A. and R.]

WATSON, S. J. **Silage as a feeding stuff, and how to obtain the maximum feeding value from it.** *J. Minist. Agric.* 46. 715-21. 1940. **655**

Grass silage is graded into three classes. Silage of high quality contains at least 16 per cent crude protein in the dry matter, is classed as a concentrate and can be used for production. Silage of intermediate quality contains 12 to 15 per cent protein and is classed as a good quality roughage. Poor quality silage includes silage not well made and silage made from mature material. Up to 70 lb. per head of high quality silage was given daily to milking cows for a whole winter at Jealott's Hill Experiment Station. [N. A. and R.]

WATSON, S. J., and FERGUSON, W. S. **The chemical composition of grass silage.** *J. agric. Sci.* 27. 1-42. 1937. **656**

A short account is given of the main changes which take place during the ensilage process. Details are given of the methods of analysis used in examining samples of silage for pH, crude-protein, volatile base, amino acid, lactic acid, total volatile acid, acetic acid and butyric acid contents. The results of the examination of 293 samples of silage are discussed. Of these 258 were made from grassland herbage, 24 from silage crops, 9 from sugar-beet tops, and 2 from potatoes. The silages were made in towers, wood-lined pits, and a small number in stacks or clamps. The samples are divided up into those made by the ordinary process, with added molasses, with added whey, with moderate amounts of mineral acid with or without molasses, and with mineral acids added in amounts sufficient to bring the mass rapidly to a pH of 3.0—4.0 (the AIV process). For comparative purposes the silages made by these processes have been divided, within each process, into groups of varying reaction.

The greater number of the ordinary grass silages had a pH of 4.5—5.0 (46 per cent). The majority of the remainder (31 per cent) lay between 4.0 and 4.5, and only four samples lay below pH 4.0. With the addition of molasses better results were obtained, and 47 per cent showed pH values of 4.0—4.5, and 29 per cent were under pH 4.0. The small number of samples with added whey and moderate additions of mineral acid were also good, average pH 3.86 and 4.32 respectively. The AIV process produced excellent silage, 69 per cent of the samples lying below the desired pH maximum of 4.0 (45 per cent between 3.5 and 4.0), and 21 per cent had an average value of 4.17. The product from silage crops was similar to the grass silages. The addition of acid to sugar-beet tops resulted in a distinct improvement over silage made with no addition. The formation of volatile basses was greatest in the ordinary silage, but the addition of molasses, or of mineral acid according to the AIV process, reduced this considerably, the degree of base formation being proportional to the acidity of the mass as measured by its pH value. At the pH levels at which these two later types of silage overlapped, there was no difference in the efficiency of the processes. The still greater acidity developed in the AIV process reduced the percentage of volatile base nitrogen in the total nitrogen from some 7 down to 4 per cent—a very small difference. The AIV process reduced the formation of amino acids to a minimum, and the molasses process gave the highest proportion of amino acids, which were, however, as with the AIV process, always in considerable excess of the volatile bases. Consideration of silages of high-protein content confirmed the above findings for material with added molasses or mineral acid, but accentuated the disadvantages of the

ordinary process. The formation of lactic acid in ordinary silage is proportional to the pH of the mass, as is also the case with molassed silage, though the values for lactic acid are higher. The lactic acid falls as the pH rises. The non-volatile acidity in AIV fodder is not all due to lactic acid, but, as might be expected, is relatively high.

The volatile acidity, on the other hand, rises with the pH, but is kept at a relatively low level in the AIV process. Up to pH 4.8 there is no difference between any of the three processes, but above this value the volatile acid content of ordinary silage rises rapidly, due to an increase in butyric acid. The formation of butyric acid is difficult of control in ordinary silage, more particularly in material of high protein content. The addition of mineral acids reduces the chances of butyric fermentation markedly, but the molasses process is as efficient in this regard as is the AIV process. There is distinct evidence that butyric acid may be formed in silage at pH levels below 4.2—the supposedly critical point—but the amounts are relatively low, and it can be accepted in principle that in well-made silage, where the pH is not in excess of 4.5, the quantity of butyric acid present will be negligible for all general purposes.

In conclusion, it may be stated that though the ordinary process of silage making may be adequate for material at a fairly advanced stage of growth, it is not suitable for high protein silage, though with due care good quality silage can be made from such material without any addition. To obtain greater certainty of first-class silage, molasses or acid should be added during the filling of the silo, due precautions being taken in the packing of the material. Judged by chemical characteristics there is no important difference between the two processes, and it is necessary to take into account the relative losses of nutrients and other economic factors before a final decision can be made as to the relative overall efficiency of the molasses and the AIV processes.

WATSON, S. J., and FERGUSON, W. S. **The losses of dry matter and digestible nutrients in low-temperature silage, with and without added molasses or mineral acids.** *J. agric. Sci.* 27. 67-107. 1937. [Jealott's Hill Res. Sta., Bracknell, Berks.] **657**

The results of a series of experiments extending over 4 years are reported. A discussion is given on the methods of measuring the nutritive losses in silage making. A general survey of all the comparative data shows that the ordinary process of silage making, properly applied, does not result in large losses, even where material of fairly high protein content is used. The addition of molasses, however, gives a better quality of silage and is the ideal method. Although the AIV process gives silage with the lowest losses, its advantage over the molasses process is not sufficient to justify general application.

In the case of grass silage no addition is necessary if the crop is at a fairly advanced stage of growth, but if cut whilst relatively young molasses should be added at the rate of 15-30 lb. per ton, rising with the crude protein content, to ensure that suitable fermentation follows.

The average and range of losses of dry matter, starch equivalent, protein equivalent and digestible crude protein by the different processes examined are tabulated. [N. A. and R.]

WATSON, S. J., and HORTON, E. A. **Composition, digestibility and nutritive value of samples of grassland products.** *J. agric. Sci.* 26. 142-54. 1936. [Imp. Chem. Ind., Agric. Res. Sta., Jealott's Hill, Bracknell Berks.] **658**

The composition, digestibility coefficients and digestible nutrients of a large number of samples of fresh grass, silage, hay and artificially dried grass are tabulated. Curves have been prepared from these figures which enable the starch equivalent and protein equivalent to be obtained, by interpolation, from the value for crude protein determined by analysis.

The method of calculating the starch equivalent of artificially dried grass from the data for digestibility and composition is discussed with particular reference to the fibre correction factor. It is considered that this should be the same as that used for the fresh grass prior to drying.

A number of miscellaneous samples—mostly of homegrown foods—are included in the tables.

WAUGH, R. K., HAUGE, S. M., WILBUR, J. W., and HILTON, J. H. **A comparison of alfalfa-brome grass silage and corn silage for dairy cows.** *J. Dairy Sci.* 26. 921-8. 1943. [Purdue Univ. Agric. Exp. Sta., Lafayette, Ind.] **659**

A mixture of alfalfa (*Medicago sativa*) and brome grass (*Bromus inermis*) is becoming increasingly important as a rotation pasture crop for dairy farms. When made into silage and compared with corn silage for feeding value it was found that the alfalfa-brome grass silage was higher in carotene than was the corn silage and that the milk produced was richer in vitamin A.

WIGGANS, R. G. **The influence of stage of growth of corn on the composition of silage.** *J. Amer. Soc. Agron.* 29. 456-67. 1937. [Dept. of Plant Breeding, Cornell Univ. Ithaca, N.Y.] **660**

A study of the dry matter content of corn varieties was undertaken with the object of obtaining information relating to the choice of varieties best adapted for ensilage in a given region. Providing the crop has flowered, late maturing varieties provide more green

weight than earlier varieties which, however, contain a higher percentage of dry matter and produce more dry matter during the period of elongation than later varieties. However there is less variation in the quantity of feeding units produced by varieties varying widely in dates of maturity than is generally supposed. After September 20th grain is largely produced at the expense of previously elaborated plant material. For any given region extremely late varieties, producing little or no grain by the ideal harvest period, are unsuitable for ensilage as are also those which are advanced in maturity towards the middle or end of the silage harvest period. The best variety is that which contains a satisfactory percentage of dry matter, will not have reached the stage when grain is produced primarily at the expense of stem and leaf reserves, and gives a yield of dry matter approaching the maximum for corn under a given set of conditions.

WILSON, K. J., and WEBB, H. J. **Water-soluble carbohydrates in forage crops and their relation to the production of silage.** *J. Dairy Sci.* 20. 247-63. 1937. [Cornell Univ., Ithaca, N.Y.] **661**

It has been emphasized by Wilson that leguminous forage crops may be deficient in acid-producing carbohydrates. This, together with the fact that leguminous materail requires more organic or mineral acid to reduce its pH one unit, may explain the failures in efforts to produce silage from such highly nitrogenous crops.

The effects of time of day on content of water-soluble carbohydrates and of stage of maturity on percentage of water-soluble carbohydrates have been studied. Data from these observations are tabulated, together with those of percentage of water-soluble carbohydrates present in non-leguminous and in leguminous forage crops.

The small quantity of sugar in the tissues of legumes is one of the main reasons why legumes do not ensile satisfactorily. If the fermentable sugars contained in the legumes are supplemented to the extent of 1.5 per cent of the green weight with any fermentable carbohydrate such as sugars or the materials contained in molasses, a desirable silage can be produced. Organic and mineral acids are also used to reduce the pH value of freshly cut material. The advantages resulting from the use of phosphoric acid for preservation are noted.

WILSON, J. K. **The neutralizing power of forage crops for organic and mineral acids.** *J. Dairy Sci.* 18. 317-25. 1935. [Coll. of Agric., Cornell Univ., Ithaca, N.Y.] **662**

Medicago, Vicia, Phleum, Poa, Hordeum, Avena and corn were taken at a stage of growth in which the plants are normally cut for hay, fodder or silage. The legumes absorbed and neutralized

organic and inorganic acids to a greater extent than the non-legumes. The increasing effectiveness of the acids in changing the pH of the plant material, whether leguminous or non-leguminous, is indicated by the following order : acetic, citric, phosphoric, lactic, hydrochloric and sulphuric. Both types of plant material require more acid to change their reaction one unit at pH 4.0 than at pH 6.5. The importance of the subject from an economic aspect is stressed.

WILSON, J. K. **The pH and sugar content of forage crops before and after wilting as related to the making of silage.** *J. Amer. Soc. Agron.* 40. 541-52. 1948. [Dept. Agron., Cornell Univ.] **663**

Forage crops, mainly lucerne and other legumes, showed no appreciable increase in fermentable sugar after wilting, neither did wilting the crop nor storage of expressed juice affect the pH values materially. Greater acidity reported in silage from a wilted crop is not due to increased fermentable sugar or to respiratory products developed during wilting.

WOODMAN, H. E. and EVANS, R. E. **The chemical composition and nutritive value of the pea-canning by-products (green pea pods, pea-pod meal, pea-pod silage and molassed silage from pea haulms with pods).** *J. agric. Sci.* 34. 155-64. 1944. [Sch. Agric., Cambridge] **664**

Pea pods provide good silage if they are tightly trampled and a means for draining off the effluent is supplied. No molasses need be added during filling of the silo, because the sugar naturally present in the pods ensures favourable fermentation.

WOODWARD, T. E., and SHEPHERD, J. B. **A statistical study of the influence of moisture and acidity on the palatability and fermentation losses of ensiled hay crops.** *J. Dairy Sci.* 25. 517-23. 1942. [Bur. Dairy Ind., U.S. Dept. Agric.] **665**

The advantages and disadvantages of high and low moisture silage are given as regards palatability, carotene content, odour, leakage from silo, and keeping qualities when opened. Though a wilted crop can have a low acidity and still make good silage, legumes with more than 68 per cent moisture should be wilted or mixed with dry material, or the acidity should be increased in order to make a good odour and prevent leakage. The addition of molasses acidifies and improves the odour of high-moisture legume silage and the palatability of all silages. The addition of sulphuric or hydrochloric acid is inadvisable since they make the silage definitely unpalatable and the metal tile or concrete of the silo cannot withstand the corrosion. These acids may appear to preserve the crop, but it has been found that the carotene content of such silages is more apparent than real.

ZAFREN, S. J. **Factors influencing the changes in carotene content in silages.** *Vestn. seljskohoz. Nauk. Kormodobyvanie.* No. 3. 74–8. 1941. [Federal Inst. Fodders.] **666**

The author reviews works by Russian and foreign investigators and discusses his own experiments with silages prepared from (1) *Medicago sativa* and (2) *Helianthus annuus*. He compares the pH values and the carotene content, expressed in mg. for each 20 grm. of dry matter, of silages from lucerne cut at the flowering stage (first cutting), before flowering (second cutting), and that prepared from the young regenerating aftermath of lucerne after the second cutting.

The author contends (subject to further confirmation) that the increase of the carotene content in the artificially acidified silages was probably due to changes in the reduction-oxidation potential of the medium in the process of ripening of the silage as the result of which new formation of carotene from the carotinoid substances (xanthophyll) takes place.

ZAFREN, S. Ja. **Changes in carotene content during ensiling of green plants.** *Biohimija* 9. 119-25. [English summary 125.] 1944. **667**

The carotene content of silage is stated to be higher than in fresh plants. The increase of carotene, after the fresh plant material has been treated chemically (e.g. according to the AIV method), is even greater than without such treatment.

The formation of new carotene, additional to that already present in the green plant, takes place in the still living tissue of the plants after ensiling, and is the result of enzyme action. Plant tissue which before ensiling is killed by heat or macerated and finely divided will not contain additional carotene after being ensiled. Nor will it be contained in the macerated material even after being chemically treated with acid during ensiling.

The author believes that during the ensiling process xanthophyll is reduced to carotene, provided conditions are such that the opposite process of oxidation is absent or insufficiently vigorous to overcome the reduction. Such conditions may arise naturally, as a result of acidity which the silage acquires in course of fermentation, or be supplied artificially by treating the plant matter with a mineral acid before ensiling begins.

ZUBRILIN, A. A., and NIKOLAEVA, L. I. **Wastage of protein in ensilage.** *Vestn. seljskohoz. Nauk. Kormodobyvanie.* No. 1. 95-102. [English summary, p. 102.] 1940. [Williams' Federal Fodders Research Institute.] **668**

Silages were prepared from (1) *Festuca pratensis*, and (2) *Phleum pratense* at different intervals after cutting. To exclude the influence of bacterial flora, plants were previously treated with

volatile antiseptics (toluol + chloroform) and the resulting biochemical changes (actually due to the process of anaerobic auatolysis and not to that of ensiling) were noted. Before undertaking the preparation of silages, one should—to determine the possible wastage of protein complex in the raw material—at least know the degree of activity of the proteolytic enzymes in its relation to the different pH values.

J. DIGESTIBILITY AND EFFECTS ON ANIMAL PRODUCTS

AARSBERETNING FORSØGSMEJERI. Ostningsforsøg med Maelk fra Køer fodret med AIV Ensilage. [**Making cheese from the milk of cows fed on AIV silage.**] *Aarsberetn. Forsøgsm.* 1938-1939. pp. 82-6. **669**

Danish, Swiss and Gouda cheeses were made from the milk of cows to which AIV silage had been fed, control cheese being made from ordinary mixed milk. There was no smell or taste in the milk that could be traced to the silage but the milk was deeply coloured. The experiments gave no clear indication that the "silage" milk was less useful than the control milk for cheesemaking, but it was emphasized that the silage used was of particularly good quality. [D. S. A.]

AIKKINEN, I. Jämförande utfodringsförsök med AIV-foder och ensilage berett med tillsats av salt och surmjölk. [**Comparative feeding trials with AIV fodder and ensilage prepared by adding salt and sour milk.**] *Tidskr. Lantm.* 17. 106-9. 1935. **670**

In feeding trials conducted by von Frenckell in Finland 27,102 kg. fresh clover aftermath converted into AIV fodder compared with the same amount of aftermath made into salt, sour milk, ensilage showed a gain corresponding (in Finnish marks) to 1,920 : 30.

As this quantity of fodder corresponds approximately to the yield of clover obtained from one hectare, the gain resulting from the use of the AIV method compared with the salt and sour milk method is to be regarded as meriting careful attention.

ALASKA Agricultural Experiment Station Progress Report 1938-1941. **Oat and pea ensilage as a substitute for dry cured hay for dairy cows in Alaska.** 1942. pp. 7-8. **671**

Five feeding trials with oat and pea silage were conducted between 1937 and 1941. The milk production of the cows fed oat/pea silage, hay, and 10 lb. of concentrates per day was better than the production of those fed oat/pea silage *ad libitum* and 10 lb. of concentrates. Three lb. of oat/pea silage replaced 1 lb. of hay. [D. S. A.]

ALASKA Agricultural Experiment Station. Progress Report 1942-1943. **Oat and pea ensilage as a substitute for dry cured hay for dairy cows in Alaska.** p. 7. 1946. **672**

Final results substantiated earlier conclusions. From December 1941 to April 1942 the daily average milk yield and butterfat yield per Holstein cow were 39.98 and 1.19 lb. respectively when an average of 104.82 lb. of oat/pea silage and 11.45 lb. of grain were fed per day, and 42.7 and 1.45 lb. respectively when an average of 56.5 lb of oat/pea silage, 11.5 lb. of grain, and 13.2 lb. of hay were fed daily. [D. S. A.]

AMOS, A. Ensilage.—VII. **The feeding of silage.** *J. Minist. Agric.* 32. 223-32. 1925-26. **673**

AMOS, A. **Four feeding experiments with silage.** *J. Minist. Agric.* 35. 924-34, 1020-30. 1928. **674**

(1) A short account is given of the difficulties to be overcome conducting feeding experiments with silage.

(2) Three feeding experiments comparing oat and tare silage with oat and tare hay and one experiment comparing maize silage with roots are described. In all 68 animals were concerned in the experiments.

(3) The average daily increase in live weight of three experiments of animals fed oat and tare silage was 1.56 lb. compared with 1.23 lb. of similar animals fed oat and tare hay—an advantage of 0.33 lb. gain per animal per day in favour of silage, and equal to 60 lb. over a period of six months.

(4) In the maize silage experiment, in which maize silage was compared with roots on a basis of equal starch equivalents (theoretical), the increases in live weight were to the advantage of maize silage, thus indicating that its actual starch equivalent is at least as good as the theoretical figure.

ANAND INSTITUTE OF AGRICULTURE. Annual Report 1943-1944. (Gen. Ser. Bull. No. 4.) **The effect of feeding silages on milk yield.** p. 28. 1945. **675**

For two weeks three groups of 18 Kankrej cows were given experimental rations of 30 lb. of zinzvo (*Andropogon annulatus*) silage, packed lightly or heavily or molassed, together with concentrates and hay to appetite. A slight but insignificant increase in the milk yields of all three groups occurred. A similar 2-week comparison of maize silage and varelu (*Ischaemum rugosum*) silage showed maize silage to increase milk yield insignificantly and varelu silage not at all. [D. S. A.]

ARCHIBALD, J. G., and PARSONS, C. H. **Investigation of the merits of legume and grass silage for Massachusetts agriculture.** Massachusetts Agric. Exp. Sta. Annual Report 1938-1939. Bull. 369. pp. 18-9. 1940. [Amherst, Mass.] **676**

Earlier work has been continued. Phosphoric acid silage was less palatable and produced slightly less milk, though this milk was of a better flavour, than corn silage or molases silage. Gains in weight were less when phosphoric acid silage was fed than when the other silages were fed. [D. S. A.]

ARCHIBALD, J. G., and PARSONS, C. H. **Investigation of the merits of legume and grass silage for Massachusetts agriculture.** Massachusetts Agric. Exp. Sta. Annual Report 1939-1940. Bull. 378. p. 21. 1941. [Amherst, Mass.] **677**

Results of an earlier experiment were confirmed in double-reversal feeding trials with fourteen cows. [D. S. A.]

AXELSSON, J. AIV fodrets smältbarhet och neutralisering. [**Digestibility and neutralization of AIV fodder.**] *Lantm. Svenskt Land* 26. 155-6. 1942. **678**

The increased preparation of AIV fodder in recent times in Sweden as well as in other countries has brought into prominence the question of this fodder's digestibility and the factors which influence it. According to Møllgaard the coefficient of digestibility for the AIV fodder's digestibility decreases by 3.0 units on neutralization with calcium carbonate and by 15.2 units on neutralization with sodium bicarbonate. The methods employed in Møllgaard's experiments include great possibilities of error, as pointed out previously (*Lantm. Svenskt Land*, 1941, p. 707). Steensberg and Winther in the 199th Report from the Experiment Laboratory have recorded recent Danish experiments which refute Møllgaard's view. The material of these digestibility trials has been analysed in the usual way, and regarding the chemical composition of green lucerne, AIV fodder and lucerne hay, the ensilage shows a slightly higher content of dry matter (20.7 per cent) than the green fodder (18.1 per cent). In the dry matter the green fodder contained the highest content of protein (22.01 per cent) followed by AIV fodder (20.82 per cent). The hay contained 19.34 per cent. The content of crude fat was highest in the AIV fodder and lowest in the hay. Of N-free extractives, AIV fodder had the lowest content. Even the hay had a slightly lower content than the green fodder. The content of fibre was lowest in the green fodder. The AIV fodder contained approximately 3 and the hay approximately 7 units more than the green fodder. The ash content was slightly lower in the hay than in the other kinds of fodder.

The digestibility of each kind of fodder was determined for three cows. The fodders tested constitute the only feed of the cows during the period of the experiment. The daily quantity of AIV fodder amounted to 28 kg. The pH-value was on the average 4.3. For neutralization, 180 grm. sodium carbonate were added, an

amount which is considerably larger than that generally employed in practice. The following results were obtained: [A=green lucerne; B=AIV lucerne; C=lucerne hay]

Co-efficient of digestibility for:	A.	B.	C.
Crude protein	83	79	75
Crude fat	60	67	44
N-free extractives	77	55	71
Fibre	51	61	56
Organic matter	71	71	66

The organic matter has the same coefficient of digestibility for AIV fodder as for green fodder. Beforehand it would have been expected that the coefficient for green fodder would have been slightly higher than that of AIV fodder.

The sodium bicarbonate has therefore had no effect on the digestibility of the AIV fodder. Thus basic salts can be added in considerably larger quantities than those recommended for practical use, but owing to this a tendency to depression of digestibility appears.

If the feeding stuff is well digested, completely normal nutritive value can be expected. This applies also to AIV fodder. Practical experience has shown that the nutritive content of the AIV fodder is utilized as completely as that of the other fodder. At the Institute for Animal Feeding the rule recently has been that if the total fodder has contained the amount of calcium calculated to be sufficient for the animal's requirements and 1.6 grm. more per kg. AIV fodder, basic salts are not considered necessary. This is due not to the fact that the addition of such salts might involve some risk, but only that it entails unnecessary expense. This rule might be followed everywhere.

AXELSSON, J., and HELLBERG, A. Bryggeridravens ensilering samt ensilagets värde och användbarhet för mjölkkor. [**Ensiling of brewers' grains and the nutritive value and utilization of the silage for milk cows.** *Svenska BryggFören* 8. pp. 1-16. 1941. **679**

AIV silage was made from brewers' grains; it contained 29.2 per cent of dry matter, and 24.0 and 11.7 per cent of crude protein and fat in the dry matter. The pH was 3.53 to 3.86. Iodine values of the crude fat before and after ensiling were 102 and 78. The silage was pleasant in taste and smell and of high quality. Digestibility trials with two wethers gave the following digestibility coefficients: crude protein, 81.6; crude fat, 90.7; soluble carbohydrates, 62.3; and crude fibre, 55.9.

In feeding experiments the food stuffs fed to six groups of cows (four cows in each group except one with three cows) were wheat, straw, clover hay, bruised mixed grains and a rich oil cake mixture,

plus alfalfa silage, replaced during periods by an equivalent amount of brewers' grains silage ; in some periods a mixture of coconut and palmnut cakes was fed in addition to the brewers' grains silage. Food requirements were estimated by Axelsson's standard in which the amount of digestible energy in 1 kg. of ground barley is denoted as 1 fodder unit, and which prescribes 5.5 fodder units per 550 kg. of live weight daily for maintenance plus in normal cases 0.40 fodder units per 1 kg. of 4 per cent milk. Over the whole period investigated the former figure worked out at 5.56 fodder units per cow daily for maintenance, the total fodder units per cow daily being 12.66. That is, 7.1 fodder units per cow daily sufficed for the production of an average of 16.62 kg. of 4 per cent milk per cow daily. The digestible protein standards were 80 g. per unit of maintenance fodder and 160 g. per unit of production fodder.

The results showed that coconut and palmnut cakes could compensate for the depressing effect on milk fat percentage of brewers' grains silage, and for this purpose 0.25 kg. of mixed coconut and palmnut cakes for every kg. of brewers' grains silage fed is recommended. It was shown that the weightening effect of brewers' grains silage on iodine values is greater than the depressing effect of coconut and palmnut. In winter feeding when the tendency is for too hard butter, brewers' grains silage has a favourable effect on butter consistency. [D. S. A.]

BABCOCK, C. J., and HALLER, H. S. **The effect of some silages on the Cu tolerance of pasteurized milk.** *J. Dairy Sci.* 26. 563-70. 1943. **680**

The feeding of molasses-alfalfa silage, straight alfalfa silage, soybean silage or corn silage had no significant effect on the amount of copper required to produce an oxidized flavour in the milk. [D. S. A.]

BECHDEL, S. I., STONE, R. W., WILLIAMS, P. S., and MURDOCK, F. R. **Legume silage in dairy feeding.** *J. Dairy Sci.* 25. A148-9. 1942. [Agric. Expt. Sta., Pa.] **681**

Results of four feeding trials with dairy cattle revealed that legume silage makes possible the feeding of smaller amounts of concentrates for milk production and also concentrates with a relatively low percentage of protein. Alfalfa silage should be fed in connexion with some hay and also with corn silage if it is available. Alfalfa-molasses silage and alfalfa-phosphoric acid silage are equal in feeding value for milk production. Milking cows tend to go " off feed" when fed heavily on phosphoric acid legume silage. The feeding of pulverized limestone with this silage is advised. Eighty pounds of molasses or 18 lb. of 73 per cent phosphoric acid per ton of green alfalfa are considered the optimum amounts of preservative to use.

BECHDEL, S. I., and WILLIAMS, P. S. **Alfalfa-molasses silage for heifers.** Pennsylvania Agric. Exp. Sta., 51st Annual Report. Bull. 367. 1938. pp. 37-8. **682**

BECHDEL, S. I., and WILLIAMS, P. S. **Alfalfa-molasses silage for milk production.** Pennsylvania Agric. Exp. Sta. Annual Report 1937-38. Bull. 367. 1938. pp. 37-8, [State Coll., Pa.] **683**

BECHDEL, S. I., WILLIAMS, P. S., BORLAND, A. A., and SHIGLEY, J. F. **Results of a long time feeding experiment on bone meal vs. no bone meal in a dairy ration consisting of timothy hay, corn silage and concentrates.** *J. Dairy Sci.* 22. 447-8. 1939. **684**

BEINERT, B. Untersuchungen über die Eignung von Gärfuttermilch für Käsereizwecke. [**Suitability for making cheese of milk from cows fed silage.**] *Forschungsdienst* 4. 571-82. 1937. **685**

This is a review of the literature on the subject under the headings: hard cheeses (Emmentaler, Dutch and Tilsit) and soft cheeses.

BENDER, C. B. **Feeding of grass silage to dairy cows.** *Cert. Milk* 14. 163-5. 1939. **686**

BENDER, C. B. **The evaluation of grass silage as a succulent feed.** *J. Anim. Sci.* 1. 347-8. 1942. **687**

BENDER, C. B., BARTLETT, J. W., TUCKER, H. H., and MIXNER, J. **Molasses grass silage as the sole roughage diet for milk production and growth of dairy animals.** *J. Dairy Sci.* 20. 424-6. 1937. **688**

BJERRE, S. **Effect of silage on quality of dairy products.** *Vort. Landburg.* 53. 155-7. 168-71. 1934. **689**

BOHSTEDT, G., RUPEL, I. W., KING, W. A., PETERSON, W. H., and HEGSTED, D. M. **Palatability and nutritive value of AIV- and molasses-alfalfa silage for dairy cows.** *Proc. Amer. Soc. Anim. Prod.* 1937. pp. 51-4. [Univ. of Wisconsin] **690**

Although alfalfa silage may fit admirably into a field and herd management scheme, it cannot be made the equivalent of pasture in the winter, neither in its palatability nor its carotene content. The stage of cutting alfalfa for silage, as well as variation between cows regarding their reaction to the silage, are factors which must be considered.

BORIŠENKO, E. Ja. [**The influence of clover silage on the milk production of dairy cattle.**] *Trudy Vologod. Moločno-Hozjaĭst. Inst.* Inst. Bull. No. 81, 71-103. 1929. **691**

BORZHOVSKI, S. E. [**The effect of ordinary and chemically preserves ensilage on the metabolism of the animal organism. 5. Data on the offspring.**] *Ukrain. Biochem. J.* 16. 143-57. 1940. [Inst. Biochem. Acad. Sci., Ukrain, S.S.R.] **692**

BOYLE, C., and RYAN, J. J. **Grass silage.** *Econ. Proc. Dublin Soc.* 2. 515-28. 1933. [Univ. Coll., Cork] **693**

Ensiled grass from a concrete pit silo is capable of replacing hay and roots, or portions of the hay and root feed in a dairy cow's ration, whether made from mature grass or grass at the aftermath stage. Records of losses and correlation of milk yields with types of feed show that 7 lb. of hay and 28 lb. of roots can be adequately replaced by 35 lb. silage.

BRACCINI, P. Ricerche sul pH del latte di pecora in rapporto all'alimentazione con silaggio. [**The pH of the milk of sheep fed on silage.**] *Ital. agric.* 79. 354-8. 1942. [Fac. Vet. Med., Univ., Turin] **694**

A control group of 5 sheep received hay *ad libitum* for the whole of the experimental period ; the experimental group of 5 sheep was given grass silage, of a pH of 4.20 and containing 1.85 per cent of lactic acid and 0.30 per cent of acetic acid, *ad libitum*. The experiment included a preparatory period of 106 days and a test period of 10 days followed by a 10-day transition period and a 20-day test period on hay. There was no real difference in the pH of the milks of either group at any stage of the experiment. [D. S. A.]

BROUWER, E., and DIJKSTRA, N. D. Over den invloed van gras, geënsileerd zonder toevoeging van mineraal zuur, in vergelijking met hooi, op het zuur-base-evenwicht van het rund. [**On the effect of grass ensiled without the addition of mineral acids, in comparison with hay, upon the acid-base balance in cattle.**] *Versl. Landbouwk. Onderzoek.* No. 41.C. 561-73. [German summary, 73.] 1935. **695**

No acidosis occurred after feeding 20—30 kg. per day grass silage of butyric acid type, nor after 20 kg. of the lactic acid type. The organic acids of the feed are oxidized to a great extent. [N. A. and R.]

BROUWER, E., and DIJKSTRA, N. D. **The acid-base equilibrium of cattle as influenced by hay and grass silage without mineral acid addition.** *Biederm. Zbl. B. Tierernähr.* 7. 361-71. 1935. **696**

BROUWER, E., and DIJKSTRA, N. D. Über den Einfluss von Gras, ensiliert mit und ohne Zusatz von Mineralsäure, auf Säurebasengleichgewicht, Gesundheit und Ertrag von Milchkühen. [**The**

influence of grass, ensiled with and without the addition of mineral acid, upon acid base balance, health and milk production of dairy cows.] *Bierderm. Zbl. B. Tierernähr.* 8. 340-53. [English summary, 353.] 1936. **697**

Results are given of a feeding trial with two groups of 12 cows. Use of mineral acid in making grass silage caused a moderate shift of the acid base equilibrium to the acid side. This could be prevented by additions of chalk or soda. Appetite and yield of milk, fat and dry matter were not affected, but the live weights of the cows tended to fall. There was some evidence of change in the physicochemical properties of the milk, notably with regard to separation of cream and reaction with rennet, but confirmation by further trials is required. [N. A. and R.]

Brouwer, E., and Dijkstra, N. D. I. Vergelijkende voederproef omtrent den invloed van gras, geënsileerd met en zonder toevoeging van mineraal zuur, op zuur-base-evenwicht, gezondheid en opbrengst van melkkoeien. II. Practische ervaringen en wenken omtrent de extra-toediening van krijt en soda bij voedering van mineraal-zuur-silage. [**I. Comparative feeding trial to test the influence of grass, ensiled with and without the addition of mineral acid, upon acid base balance, health, and milk production of dairy cows. II. Practical experience and advice relating to extra rations of chalk and soda when feeding with mineral acid silage.**] *Versl. Landbouwk. Onderzoek.* No. 42 (8). C. 291-333. [German summaries, 322-4 and 333.] 1936. [Rijkslandbouwproefstation, Hoorn, Holland] **698**

Buenger, H., Fissmer, E., Schmidt, H., and Naegelsbach, A. Fütterungsversuche mit Einsäuerungsgemischen von Kartoffeln und Süsslupinen-Grünfutter. [**Feeding experiments with silage mixtures made from potatoes and green sweet lupins.**] *Z. Schweinez.* 49. 211-3. 1942. **699**

Buenger, H., Schmidt, H., Naegelsbach, A., and Huelsen, K. Weitere Fütterungsversuche mit Gemischen von Sauerkartoffeln und Süsslupinen-Gärfutter. [**Further feeding experiments with mixtures of potato and sweet lupin silage.**] *Z. Schweinez.* 50. 137-8. 1943. [Inst. Milcherzeug., Kiel] **700**

An experiment is described with 4 groups of pigs in which the " satiety " ration was of potato silage with 0, $\frac{1}{2}$, $\frac{1}{3}$ or $\frac{1}{4}$ of sweet lupin silage, made and fed separately, with a concentrate ration of grain and sugar beet slices. This was fed for 14 weeks. The higher proportion of sweet lupin silage reduced potato consumption and the stems of the sweet lupins were rejected. After transfer to the fattening ration of potatoes and carrots, the sweet lupin pigs ate most and put on weight fastest. [N. A. and R.]

CARBONE, E. **Silage feeding to laying hens.** *Proc. Seventh World's Poultry Congr. Cleveland, Ohio.* 1939. 202-3. **701**

COLE, C. L., DONOVAN, R. L., and ALLEN, N. N. **The influence of sunflower silage upon milk production.** *J. Dairy Sci.* 20. 221-30. 1937. [North Central Expt. Sta., Grand Rapids (C.L.C. and R.L.D.) and Univ. Minnesota, St. Paul (N.N.A.).] **702**

The inclusion of *Helianthus* silage in a ration containing an abundant supply of legume hay produces no advantages in milk production or health of the cows, and it is therefore concluded that the provision of such succulent feed is not justified by the expense incurred

CRASEMANN, E. Ueber den Einfluss des mit Mineralsäuren konservierten Grünfutters auf den Mineralstoffwechsel, insbesondere auf den Säure-Basenhaushalt des Wiederkäuers. [**The influence of silage made with mineral acids upon the metabolism, especially the acid-base balance, of ruminants.**] *Rep. Fourth Internat. Grassl. Congr. Gt. Britain* 1937. Sectional Session 5, pp. 408-16. [English summary, pp. 414-5, Discussion, 427-32.] **703**

Economic and nutritional considerations have led to increased attention being devoted to the production and conservation of crude fodder of varied and rich composition, whether green fodder, or hay and silage from meadows, pastures, and ploughed land. Of especial importance is the mineral composition of this crude fodder, which represents for many animals the principal, and for some the only source of nutrition. Through conservation its content of minerals and their mutual relations are more or less altered, especially since the practice of ensilage with the aid of mineral acids has been adopted. These acids bring about a change in the proportion of the acidifying and alkalizing elements and compounds, to the detriment of the latter. Thus silage made with mineral acids produces in the organism an acid action, the extent of which is dependent upon the quantity and composition of the inorganic acids employed, the mineral composition of the material ensiled, the duration and intensity of the feeding with silage, the base content of other rations fed to the animals at the same time, and also upon the species, the condition, and the performance of the animals.

The organism seeks to escape the acidifying action of the fodder by regulation of the acid-base balance. The acid metabolic products, so far as they are not oxidized to carbon dioxide and water, are for the greater part split up and excreted. The organs concerned herein are primarily the intestinal canal and the kidneys. Through the kidneys the remains of the acid are excreted mainly as ammonium, alkali and calcium salts. When mineral acid silage is fed to animals an increase in the ammonium and calcium content of

the urine is therefore observed, and a decrease in the alkaline bicarbonates, which produces acidity in the normally alkaline urine of the ruminant.

When there is one-sided employment of mineral acid silage the basic elements and compounds of the fodder are no longer sufficient to neutralize the acid metabolic products. In this case the base reserves of the tissue are attacked. When a large quantity of chlorine ions in the form of hydrochloric acid silage has been introduced into an animal, a diminution in the alkali reserves of the blood plasma and a slight increase in the degree of acidity together with an increase in the chlorine content have been determined. These are symptoms of incipient acid poisoning. With the exclusive use of silage conserved with sulphuric acid these symptoms were not determined. Very often a one-sided employment of mineral acid silage led to a disturbance of the calcium and phosphorus balance.

The not inconsiderable effect of green fodder conserved with the aid of mineral acids of any kind upon metabolism and acid-base balance may, so far as is yet known, be avoided if rations of hay with high mineral content are given together with the not unduly acidified silage. A good result may also be obtained by the giving of bicarbonate or carbonate of soda. The giving of calcium carbonate (prepared chalk) on the other hand, very often does not produce the desired result. A certain addition of basic salts to rations is justified even when hay or aftermath, is fed at the same time as silage, as the hay does not always contain a sufficient base surplus.

The above communication is based upon the research of E. Brouwer, A. Grassmann, W. Kirsch, F. Gramatzki, E. Kämpfe and F. Schnepf, and upon experiments conducted by the author in cooperation with his colleague, W. Schoch. The investigations cannot be regarded as concluded. It is desirable above all that further long duration trials, simply and clearly planned, should be carried out with different categories of animals.

CRASEMANN, E., and CHRISTEN, F. Bericht über Versuche betreffend Eignung von Maissilage zur Erzeugung von Buttereimilch. Winter 1937/1938. [**The suitability of maize silage for the production of milk for butter making. Winter 1937/1938.**] *Ann. agric. Suisse* 41. 27-54. 1940. **704**

The butter from the milk of cows receiving 15 to 20 kg. per day of maize silage was compared, under the same conditions of manufacture, with typical Swiss sour-cream butter from control cows on their normal rations. The experimental feeding was carried out for three periods of a week at each of nine centres during the winter of 1937-38. During the first and second experimental periods only four of the centres fed the silage after milking, although they had

been warned that feeding it before or during milking might affect the milk. During the third experimental period all the centres fed the silage after milking. The taste and odour of the milk and cream were normal, or difficult to distinguish from normal, in all cases ; but the butter from the milk of cows given silage before or during milking had a strange fodder-like or oily taste and odour. Consequently the average grading score of the silage butters from the first and second experimental periods was statistically significantly lower than that of the normal butters. The average score of the silage butters from the third experimental period, when all centres fed the silage after milking, was slightly but not significantly lower than that of the normal butter. Details are given of a series of chemical and bacteriological tests that were applied to the butters and the butterfats. Small significant differences were observed in the iodine value, refractometer numbers, and solidifying points of the silage and normal butterfats, but the abnormal taste and odour of certain of the silage butters was not elucidated. [D. S. A.]

CRASEMANN, E., and TSCHERNIAK, A. Ueber die Verdaulichkeit von Mineralsäuresilage beim Haushuhn. [**Digestibility by poultry of silage made with added acid.**] *Arch. Kleintierzucht* 1. 95-9 and 140-8. 1940. **705**

Two Rhode Island Red cocks were used in 3 digestibility experments of 18 days' duration with 2 differently prepared red clover silages. The first was prepared with HCl and H_2SO_4 and the second with Penthesta red and H_2SO_4 and 30 g. of the silages were given daily in addition to 70 g. of ground maize for which the digestibility coefficients were also determined separately. [N. A. and R.]

CRASEMANN, E., and TSCHERNIAK, A. Grünfuttersilage als Schweinefutter. [**Green fodder silage for pigs.**] *Schweiz. landw. Mh.* 19. 219-28. 1941. **706**

A supplement of silage improved fattening rations for pigs. A saving of up to 6.45 per cent of concentrates could be made. The effect was good. Consumption of protein and energy value were slightly reduced as compared with controls. [N. A. and R.]

CRASEMANN, E., and WIDMER, A. Silofutter und Butterqualität. [**Silage and butter quality.**] *Schweiz. Milchz.* No. 93. 1935. pp. 10. [Eidg. Tech. Hochsch., Zürich] **707**

A report of preliminary experiments conducted in 1935 to test the effect upon dairy products of feeding cows on silage made from slightly wilted grass, grass silage made by the AIV process, and maize ensiled by the usual Swiss process.

DAWSON, J. R. **Dairy cows when dry can be wintered on legume silage alone.** *U. S. Yearbook of Agriculture.* 1930. pp. 221-2. **708**

DE WILDT, J. C. DE R. [**Silage making with tops and leaves of sugar beet and a feeding experiment with milk cows. Comparison with grass silage made by the Dutch method.**] *Versl. Landb. Onderzoek.* 1935. No. 41C. 211. **709**

Soiling of the material causes considerable losses in the making of silage, and probably decreases the digestibility of protein, but not of crude fibre. The food value of the fodder decreases, the animals lose appetite, and digestive disorders (diarrhoea) sometimes occur. In a feeding experiment with two groups of 13 cows each, in which beet silage was compared with grass silage, the starch values of both rations being equal, no difference was found in milk production. A daily ration of 24 kg. beet silage, equivalent to 15 kg. grass silage, was readily eaten. The physical constants of butter fat, Reichert-Meissl, Polenske and iodine numbers were found to be slightly higher with beet silage. [N. A. and R.]

DIBBERN, SUDHOLT, RINTELEN and SCHÄTZEL. Fütterungsversuche über den Einfluss des Silofutters auf Milch und Butter, ihre Menge und Zusammensetzung. [**Feeding experiments on the effect of silage on yield and composition of milk and butter.**] *Z. Zücht. B.* 33. 409-16. 1935. **710**

Results of two tests are given with groups of 2 cows and 3 cows. Group 1 did not receive silage ; group 2 received 15 kg. and Group 3 30 kg. silage per head daily. The supplies of protein and starch equivalent were equalised by giving to Groups 2 and 3 supplements of roots and concentrates. Silage raised milk yield slightly without producing any discernible flavour, bacteriological infection, or change in chemical composition of the milk. Flavour and aroma of butter were not affected, but its colour was improved progressively by silage feeding. Melting and solidifying points of the fat were slightly lowered, but otherwise no change in the fat constants could be detected. [N. A. and R.]

DICKEY, H. C., and WILLIAMS, E. B. **Peavine silage found by tests to be good feed for dairy cows ; no off-flavour in milk.** Colorado Agric. Exp. Sta. Fm Bull. 5. 1943. pp. 12-3. [Fort Collins, Colo.] **711**

Peavine silage, a by-product of the pea canning industry, was found to have a slightly greater feeding value than good quality maize silage, when tested out on two groups of 6 cows each. The silages were fed at the rate of 20 to 25 lb. per cow per day, together with 18 to 22 lb. of alfalfa hay, and 1 lb. of grain per 4 lb. of milk

produced. The cows did not take readily to the peavine silage, but became gradually accustomed to it, and after 4 to 5 weeks ate the whole ration offered to them. In spite of its strong odour, the peavine silage did not impart any feed flavour to the milk, even when fed immediately before milking. [D. S. A.]

DIJKSTRA, N. D. Voederwaarde van in silo's geënsileerde maïs. [**Feeding value of maize silage.**] *Landbouwk. Tijdschr.* 47. No. 570. 1935. **712**

DREW, J. P., DEASY, D., O'SULLIVAN, G. F., SENIOR, B. J., and SHEEHY, E. J. **The recovery of the nutrients of grass herbage as AIV and as untreated silage and the comparative seasonal yield of nutrients from land cut for hay and for silage.** *J. Dept. Agric. Eire.* 35. 171-200. 1938. [Univ. Coll., Dublin] **713**

Th digestibility of both types of silage as determined in feeding trials with sheep and cattle was similar. Evidence was obtained that total yields from successive cuttings of plots mown for silage and for hay are connected with the incidence of rainfall during the growing period.

DUNCAN, C. W., HUFFMAN, C. F., and TOBIN, H. A. **A chemical study of ketosis in a dairy herd.** *J. Amer. vet. med. Assoc.* 95. 690-700. 1939. [Agric. Exp. Sta., East Lansing, Mich.] **714**

A herd of Jersey cows receiving a winter ration of poor quality soybean hay, corn silage and a little mixed grain suffered from pronounced ketosis. Treatment consisted of changing the ration to alfalfa hay, corn stalks, extra grain and corn sugar or molasses, and administering chloral hydrate to the worst cases. The results would seem to indicate that high-producing cows on poor rations may be in need of additional soluble carbohydrate to ensure normal fatty acid metabolism. [D. S. A.]

DUNN, K. M., ELY, R. E., and HUFFMAN, C. F. **Values of regular corn silage, grainless corn silage and ear corn silage in the dairy rations.** *J. Dairy Sci.* 30. 567-8. 1947. [Abstr. of paper read at Ann. Meeting Amer. Dairy Sci. Assoc., June 1947.] [A.E.S., E. Lansing, Mich.] **715**

Fifteen milking cows were fed alfalfa hay alone from calving until milk showed a sharp decline ; the alfalfa was then partially replaced by the feed to be tested. Clover hay and grainless maize silage were of equal value for milk production but replacing the silage by maize grain on a total digestible nutrient basis caused an average daily increase of 2.5 lb. of fat-corrected milk during the 4th 3-day period whereas partly replacing the hay by ear-maize silage caused an average daily increase of 4.7 lb. of fat-corrected milk

during the 5th 3-day period. Replacing ordinary maize silage by grainless maize silage plus corn-and-cob meal caused no significant change in milk production. [D. S. A.]

ESKEDAL, H. W. Einige dänische Versuche mit Heu und Silage als Futter für Milchkühe. [**Some Danish experiments with hay and silage as fodder for dairy cows.**] *Wiss. Ber. XI. Milchw. Weltkongr. Berlin.* 1. 196-200. 1937. **716**

ESKEDAL, H. W. Kartoffelpulp som foder til molkekøer. [**Potato pulp as a feed for dairy cows.**]

ROTTENSTEN, K. AIV-Foders indflydelse paa malkekøers calcium- og fosfor- stofskifte. [**Effect of AIV silage on calcium and phosphorus metabolism in dairy cows.**] *178th Rep. Res. Lab. Roy. Vet. Coll. Copenhagen*, 1938. pp. 39. **717**

Cows do not eat potato pulp as readily as they eat roots but up to two-thirds of the root ration may be replaced by fresh or ensiled pulp without effect on milk yield. Ensiling does not appreciably alter the composition of the pulp which is roughly in percentages: dry matter 12 to 15, crude protein 5 to 6, true protein 4.6 to 5.3, crude fat 0.31 to 0.54, N-free extractives 72 to 76, fibre 15 to 18 and ash 2.97 to 6.73.

Ca balances are presented for 4 shorthorn cows over six 10-day periods during which all were fed concentrates, and one was fed hay (lucerne and grass), one AIV silage (lucerne and grass), one silage and $CaCO_3$ and one silage with $NaHCO_3$. Unfortunately the silage used was not of uniform composition and the percentage Ca in the silage during the 2nd to the 6th periods was little more than half that in the 1st and 2nd. The carbonate and bicarbonate were calculated to be sufficient to neutralise the acid of the silage. The milk yields were not comparable in the 4 cows, nor were the Ca intakes in any way related to milk yields. Only the cow with the Ca supplement gained Ca during the experiment and the net loss was greatest in that given silage and bicarbonate. [N. A. and R.]

FISHWICK, V. C. **Feeding trials with silage.** *J. Minist. Agric.* 31. 50-8. 1924. [South Eastern Agric. Coll., Wye] **718**

GARRETT, O. F., ARNOLD, R. B., and HARTMAN, G. H. **Some factors affecting the stability of certain milk properties. II. Effect of succulent roughages and of storage conditions on colour.** *J. Dairy Sci.* 22. 813-9. 1939. **719**

Two groups of 2 Holstein and 4 Guernsey cows were fed on beet pulp, corn silage, and molasses grass silage in turn, for periods of three weeks, as the main roughage ration, and weekly samples of milk from each cow were examined for total yellow colour with the

" lactochrometer." The molasses grass silage produced milk higher in yellow colour than did corn silage or beet pulp, the average yellow colour units being 5.26, 4.57 and 4.22 for the grass silage, corn silage and beet pulp respectively. Samples of the milk, raw and pasteurized, with and without added copper salt, were also tested for colour during and after 5 days' storage. There was a small, but definite progressive loss of colour on storage, a loss which was accelerated slightly by pasteurization and more by the presence of soluble copper, but the average loss of colour in pasteurized copper treated samples by the fifth day was less than 9 per cent. The yellow colour of highly-coloured milks was more stable on storage than that of low-coloured milks. An hypothesis put forward that the loss of yellow colour is due to the deterioration of xanthophyll and zeaxanthin rather than carotene. [D. S. A.]

GARRETT, O. F., ARNOLD, R. B., and HARTMAN, G. H. **A comparison of the effects of seven different types of roughages on colour and flavour of milk.** *J. Dairy Sci.* 23. 497-8. 1940. [A.E.S., N. Brunswick, N.J.] **720**

Silage made from immature alfalfa with molasses was compared with green spring pasture. The colour of the milk produced on the silage rose rapidly for 4 weeks and its maximum value of 6.3 lactochrometer units, reached in 10 weeks, was almost equal to that produced on pasture in 3 weeks.

When molasses grass silage, phosphoric acid grass silage and corn silage were compared, it was found that the grass silages gave similar results and produced milk of higher colour, better flavour, both initially and on keeping, and with less tendency to develop oxidized flavour in the presence of copper, than the milk produced on corn silage.

In a third experiment molasses grass silage, beet pulp and molasses-impregnated citrus pulp were compared. The milk produced on grass silage was superior in all the above respects to that produced on the other roughages. No difference was apparent in the effects of the beet pulp and the citrus pulp. [D. S. A.]

GARRETT, O. F., ARNOLD, R. B., and HARTMAN, G. H. **Some factors affecting the stability of certain milk properties. IV. A comparison of seven different roughages on the colour and flavour of milk.** *J. Dairy Sci.* 24. 71-83. 1941. **721**

GARRETT, O. F., BENDER, C. B., and TUCKER, H. H. **Relation of grass silage to the colour, vitamin C and flavour in milk from individual cows.** *J. Dairy Sci.* 20. 426-7. 1937. **722**

GARRETT, O. F., HARTMAN, G. H., and ARNOLD, R. B. **Some factors affecting the stability of certain milk properties. I. Effect of succulent roughages on flavour.** *J. Dairy Sci.* 22. 717-27. 1939. **723**

Four Holstein and 8 Guernsey cows were divided into two equal groups and by means of suitable dietary changes comparisons were made of the influence on milk flavour of rations containing beet pulp, maize silage and molasses green silage. The effects of these three foods in the above order were as follows. Units of milk colour as measured by lactochrometer 4.22, 4.57 and 5.26. Milk flavour scores of fresh raw milk 20.90, 20.84 and 22.28 ; 5 days old raw milk 17.35, 17.53 and 19.73 ; fresh raw milk with 1.3 p.p.m. of copper added 20.31, 20.59 and 21.42 ; similar milk 5 days old 15.35, 16.73 and 18.57. Thus molasses grass silage proved superior to beet pulp or to maize silage in that the milk produced had a superior initial flavour, a more stable flavour on storage and a greater resistance to the catalytic effects of added soluble copper. The stabilizing effect on flavour of grass silage appeared to be due, in part at least, to the comparatively high carotene content of the food. A highly significant positive correlation was found between yellow colour and flavour in freshly drawn milk from individual cows. [D. S. A.]

GASNIER, A., JACQUOT, R., and LEROY, A. M. Utilisation du sucre-paille pour alimentation du bétail. [**Utilization of straw silage by animals.**] *C. R. Acad. Agric. France.* 1942. pp. 7. **724**

Laboratory tests with rats and rabbits, and field tests with sheep showed that ensiled straw had no nutritive advantage over untreated straw in digestibility or in N utilization. [N. A. and R.]

GERLAUGH, P., and ROGERS, H. W. **Returns per acre in steer feeding from immature corn silage, mature corn silage, and corn-and-cob meal.** *Bi-m. Bull. Ohio agric. Exp. Sta.* 28. 159-60. 1943. [Madison County Exp. Farm] **725**

Maize cut when mature and made into silage gave a better return per acre in terms of live-weight increase when fed to cattle than immature maize made into silage. Both types of silage gave better results than corn-and-cob meal on a live-weight increase per acre basis. [N. A. and R.]

GISH, C. L., PAYNE, L. F., and PETERSON, W. J. **The effect of grass silage on colour of egg yolk.** *Poult. Sci.* 19. 154-6. 1940. [Kansas A.E.S.] **726**

On the tenth day of feeding oat grass silage to hens, 25.9 per cent of the eggs laid had olive green yolks. The colour disappeared when fresh oat grass was substituted for silage. Less than half the hens were susceptible to this colour effect. [N. A. and R.]

GOOD, E. S., and GARRIGUS, W. P. **A comparison of alfalfa hay and alfalfa-molasses silage as roughages for fattening steers.** *Proc. Amer. Soc. Anim. Prod.* 32nd Ann. Meeting. 116-9. 1939. [Univ. Kentucky] **727**

The average gains per day were 1.82 lb. per head fed with hay and 2.04 lb. per head with silage.

GRAMATZKI, F. [**The influence of the acidification of silage upon its digestibility and on the nitrogen, calcium, and phosphorus balance of cattle, sheep, and swine.**] *Z. Zücht. B.* 28. 433-49. 1933. **728**

GRAMATZKI, F. [**Effect on the animal body of silage made with acid. I. Effect of addition of HCl to silage on digestibility and on the nitrogen, calcium and phosphorus balances of cattle, sheep and pigs.**] *Z. Zücht. B.* 32. 299-30. 1935. **729**

Clover silages, prepared with and without Defu solution, were compared as regards digestibility and N, Ca and P balances, when fed alone and when forming about 50 per cent of the dry matter of a ration for milk cows, bullocks and sheep. There was no indication of any difference as regards appetite or digestive disturbance with the two types of silage. They were equally well digested and gave no difference in N balance. When the acid silage was fed there was a greater amount of Ca voided in the urine, and when the silage alone was fed the Ca balance was adversely affected, this however being compensated somewhat by the other foods in a mixed ration, or by the addition of Ca phosphate. The P metabolism was not disturbed by feeding the acid silage, although in the case of one bullock a slight negative balance was recorded. It is recommended that acid silage should not be fed to furnish more than 50 per cent of the dry matter of the ration.

In the experiments with pigs potato silage, prepared with the addition of 1 and 2 per cent HCl, was compared with freshly steamed potatoes and ordinary potato silage. The use of 1 per cent of acid in the preparation of the silage had little or no adverse effect on the digestibility or utilization of the N, Ca and P of the silage. When 2 per cent acid was used, however, the digestibility was lowered as well as the N, Ca and P balances. [N. A. and R.]

GRIMMER, W. Ueber die Verkäsung von Gärfuttermilch. [**Cheese making properties of silage milk.**] *Vorratspflege u. Lebensmittelforsch.* **1.** 88-93. 1938. **730**

This paper reports orientating experiments to show the difficulties caused in cheese manufacture by the use of milk from cows fed on foods preserved by ensiling. [D. S. A.]

HALLMARK, R. P., and GARRIGUS, W. P. **The digestibility nutrients in bluegrass-molasses, alfalfa-molasses and corn silages.** *J. Anim. Sci.* 1. 354. 1942. [Univ. Kentucky] **731**

HAMDI, H. Untersuchungen an Silagemilch. Das Pufferungsvermögen von Silo- und Heumilch. [**Silage milk. The buffering power of milk from cows fed silage and hay.**] *Schweiz. landw. Mh.* 21. pp. 10. 1943. [Tech. Coll., Zürich] **732**

The mixed milk of cows fed on different types of silage showed over a wide pH-range a buffering power very similar to that of cows fed on hay. Milk from animals fed on turnip silage formed the only exception with an unusually low buffering capacity near pH 6.8, and elevated values at lower pH. Samples from individual cows gave rather fluctuating values which did not seem connected with the manner of feeding. [D. S. A.]

HANSEN, D. H., SEAMANS, A. E., and KOPLAND, D. V. **Agricultural investigations at the Huntley (Mont.) Field Station, 1927-30.** U.S. Dept. Agric. Tech. Bull. 353. 1933. pp. 50. (Experiments with dairy cattle, pp. 40-7.) **733**

HANSEN, I. G., and THORBEK, G. Næringsvædibestemmelse af roetopensilage. [**Estimation of the feeding value of root top silage.**] *Beretn. Forsøgslab. København.* No. 204. 1943. pp. 27-67. **734**

Mangold and sugar beet tops were ensiled by the AIV method in solid concrete silos. It is of advantage in making acid silage to use silos which have a solid floor and in which the drainage outlet can be closed until the silage has settled. The feeding value of the silage produced was found by metabolism experiments on dry cows. The values obtained were expressed as net calories per fattening, and it was found that 70 to 75 per cent of the metabolisable energy was stored, provided the silage was neutralised by feeding mangolds with it.

A preliminary report is made of studies of the N partition in fresh mangolds and root top silage. A large part of the N in mangolds was found in the form of amino-acid N. About 50 per cent of the total N in mangolds was in the form of true protein and about 20 per cent in the form of amino-acid N. The investigations of root top silage showed that the breakdown of N compounds was at a minimum when enough acid was added to the crop to bring the pH down to about 3.5. [N. A. and R.]

HARTMAN, R. P. **Environmental and physiological factors affecting the milk colour of Guernsey cattle.** M.S. Thesis, Rutgers University. 1939. **735**

HEGSTED, D. M., and BOHSTEDT, G. **Effect of molasses and AIV silage on the carotene and vitamin A content and the growth-promoting quality of milk.** *J. Dairy Sci.* 20. 430-1. 1937. **736**

HENDERSON, H. B., HARRISON, T. B., HINTON, S. A., and WYLIE, C. E. **Milk-flavour study.** Tennessee Agric. Exp. Sta. Report 1940. pp. 42-5. [Knoxville, Tenn.] **737**

In the above experiment the milk from the cows fed *Lespedeza* silage had a significantly better flavour than that from the other groups and a slightly better flavour than that of a control group on official test. [D. S. A.]

HIGUCHI, K., PRICE, W. V., and PETERSON, W. H. **Relation of corn and alfalfa silage to the quality of cheese and its carotene and vitamin A content.** *J. Dairy Sci.* 29. 157-62. 1946. **738**

Cheese made from milk produced on an alfalfa silage ration equalled or excelled in quality and vitamin A potency cheese made from milk produced on a corn silage ration.

HILTON, J. H., WILBUR, J. W., and HAUGE, S. M. **Silage investigations.** Indiana Agric. Exp. Sta. Annual Report 1940-1941. pp. 57-8. 1941. [Lafayette, Ind.] **739**

The nutritive values of alfalfa-brome grass silage and maize silage in rations for lactating cows were compared. The cows were divided into 2 groups and kept under experiment for 98 days. The average daily milk production for the alfalfa-bromegrass silage group was 37.1 lb. at the beginning and 29.2 lb. during the experiment as compared with 37.5 and 27 lb. for the maize silage group, which however maintained better body condition. In another short feeding experiment Leota red sorghum silage proved nearly equal to maize silage in dairy rations. [D. S. A.]

HINTON, S. A., WYLIE, C. E., and SHUEY, G. A. **Comparison of sericea silage, alfalfa silage and corn silage for dairy cows.** Tennessee Agric. Exp. Sta. Report 1940. pp. 30-3. [Knoxville, Tenn.] **740**

The experiment already described in an earlier report was carried on to 150 days. For the corn silage *Lespedeza* silage and alfalfa silage groups, total cows-days in milk were 532, 541 and 540, total milk yields were 15,933, 14,261 and 17,183 lb., and total butterfat yields were 698, 600 and 717 lb. respectively. [D. S. A.]

HINTON, S. A., WYLIE, C. E., and SHUEY, G. A. **Legume silage for dairy cows.** Tennessee Agric. Exp. Sta. Circ. 89. 1945. pp. 2. **741**

The chemical composition is given of two silages made in 10-ton silos, one from two parts of soybeans and one part of maize and the other from soybeans with 18 lb. of 70 per cent phosphoric acid per ton of fresh soybeans. In a small trial with milking cattle no significant differences in milk production were found when these two silages were compared with maize silage, all three silages being fed at the rate of 30 lb. per cow daily. [D. S. A.]

HODGSON, R. E., and KNOTT, J. C. **A comparison of the nutritive value of a home-grown hay and silage ration with an alfalfa hay ration for lactating dairy cows.** Washington Agric. Exp. Sta. Annual Report 1937-38. Bull. 368. 1938. p. 33. [Pullman, Washington] **742**

Nine cows fed on mixed hay and silage for 168 days lost an average of 128 lb. live weight, ate an average of 26.3 lb. dry matter daily and produced an average of 21.6 lb. 4 per cent fat corrected milk daily; 9 similar cows fed on alfalfa silage on the average lost 17 lb., ate 33.1 lb. dry matter daily and produced 22.5 lb. of 4 per cent milk daily. Salt and iodine were fed. [D. S. A.]

HODGSON, R. E., and KNOTT, J. C. **The nutritive value of an alfalfa hay ration compared with a mixed grass and legume hay and grass silage ration for dairy cows.** *J. Dairy Sci. 22.* 448-9. 1939. [Washington Agric. Exp. Sta.] **743**

The two rations were alfalfa hay alone, and mixed grass and clover hay and grass silage, (the hay supplying 58 per cent of the dry matter). In one experiment 9 cows were fed each ration for 168 days, and in a second experiment 4 cows received each ration for 140 days. The protein content of the alfalfa hay was 14.2 per cent, of the mixed hay 8.9 per cent, and of the silage 12.6 per cent. The average daily consumption of dry matter was 33.3 lb. on the alfalfa ration and 26.2 lb. on the other ration, in each case 95 to 96 per cent. of the dry matter fed; daily loss of weight was 0.3 lb. and 1.0 lb. respectively; daily milk production, corrected to 4 per cent milk, was 23.9 lb. and 24.5 lb. respectively in the first and second experiments on the alfalfa hay ration and 22.0 and 23.7 lb. on the hay and silage ration. [The first experiment is evidently the one described in the preceding abstract; the figures given in the two papers do not agree.] [D. S. A.]

HODGSON, R. E., KNOTT, J. C., MURER, H. K., and GRAVES, R. R. **The relation of colour and carotene content of roughage in the dairy ration to the colour, carotene content, and vitamin A activity of butterfat.** *J. agric. Res.* 57. 513-28. 1938. [U.S. Dept. Agric., Washington] **744**

The rations studied, arranged in ascending order of carotene content, were field cured hay made from mixed clover and perennial grass mixture, silage made from the same mixture, and fresh pasture grass. The last was given as grazing and in summer only, and the other rations in winter, to 3 groups of 10 Holstein cows each ; iodine and NaCl were the only supplements. Estimations of carotene content in the butterfat showed that while this tended to rise with increasing carotene intake, the rise was by no means proportional to it. The rise in total vitamin A potency, measured by tests with rats with the U.S.P. Reference cod liver oil as standard, was much greater. For instance, with hay supplying an average daily intake of 185 mg. carotene the butterfat contained 3.6 y of carotene and 50 I.U. of vitamin A per g., while the corresponding values for the butterfat of cows fed on grass silage and receiving an average daily intake af 1799 mg. carotene were 6.8 y carotene and 97 I.U. vitamin A per g. Cows fed on pasture grass secreted milk with a butterfat containing 7.9 y carotene and 105 I.U. vitamin A per g. [N. A. and R.]

HORN, V., MÜHL, E., and JUNGERMANN, K. Der Einfluss des Gärfutters auf die Milchleistung und die Butterbeschaffenheit bei teilweisem und vollständigem Kraftfutterersatz in Vergleich zur Trockenfutterung und Weidehaltung. [**Effect of silage with different concentrate supplements on milk production and butter quality compared with dry fodder and with pasture feeding.** *Landw. Jb.* 84. 83-91. 1937. **745**

In a period experiment with 3 cows, milk yield was maintained at a daily level of about 12 litres when concentrated foods were completely replaced by legume silage (beans, peas and vetches, with added mineral acid). The fat content of the milk fell by 0.15 per cent, and the amount of fat secreted by 6.4 per cent. Other milk constitutents were apparently not affected. The quality of the butter improved during the silage feeding periods. [N. A. and R.]

HORWOOD, R. E. **Alfalfa-molasses silage vs. alfalfa hay as a roughage for lactating dairy cows.** *J. Dairy Sci.* 19. 520-21. 1936. **746**

HORWOOD, R. E., and WELLS, J. G., Jr. **Alfalfa-molasse silage vs. alfalfa hay as a roughage for lactating dairy cows.** *Quart. Bull. Mich. agric. Exp. Sta.* 19. 100-4. 1936. [Upper Peninsula Sta.] **747**

In a comparison of alfalfa-molasses silage and alfalfa hay as the only roughage for dairy cows it was found that stock fed with silage consumed 15 lb. more digestible protein and 444 lb. less total digestible nutrients and produced 310 lb. more 4 per cent fat-corrected

milk. The carotene content of the alfalfa was not maintained when ensiled with molasses.

HOSTETTLER, H. Der Einfluss der Silagefütterung auf die Beschaffenheit der Milch. [**The effect of silage feeding on milk quality.**] *Mitt. Lebensin. Hyg., Bern.* 36. 50-79. 1945. **748**

HUFFMAN, C. F. **Roughage quality and quantity in the dairy ration. A review.** *J. Dairy Sci.* 22. 889-980. 1939. **749**

HUFFMAN, C. F., DEXTER, S. T., and DUNCAN, C. W. **The unknown lactation factors in corn silage.** *J. Dairy Sci.* 29. 542. 1946. [A.E.S., E. Lansing, Mich.] **750**

Milking cows were fed alfalfa hay alone for some time. When part of the hay was replaced by maize silage there was up to 24 per cent increase in production of fat-corrected milk. The silage was made from a variety of maize grown for grain, cut at the early dent stage. A second experiment showed that silage from maize grown for grain was superior for milk production to silage from maize grown for silage. [D. S. A.]

ILLINOIS Agricultural Experiment Station. Circ. 605. **Grass and legume silages for dairy cattle.** By *W. B. Nevens, K. E. Harshbarger,* and *K. A. Kendall.* 1946. pp. 19. **751**

The circular reviews the advantages and disadvantages of grass and legume silages, gives advice on how to ensile the various crops and contains a table of the estimated yield and feeding value per acre of some Illinois crops.

INDIANA Agricultural Experiment Station. Circ. 285. **Alfalfa-brome grass silage for dairy cows.** By *J. W. Wilbur, R. K. Waugh, S. M. Hauge* and *J. H. Hilton.* 1943. pp. 7. **752**

Results of two 10-week experiments with 10 and 12 cows indicate that for milk production alfalfa-brome silage is similar in value to maize silage. Eighty lb. of molasses per ton of green material were added as a preservative. The two silages were fed at a rate of approximately 3 lb. for each 100 lb. of body weight, with additions of small quantities of hay and concentrates.

The carotene contents of the alfalfa-brome silage and of the maize silage varied from 10 to 150 and from 20 to 60 μg. per g. respectively. Cows fed the alfalfa-brome silage had higher carotene contents in their blood plasma and butterfat than those receiving maize silage. The cost of alfalfa-brome silage is higher than that of maize silage.

Results are also reported of a 50-day trial with 14 Holstein cows in which 32 lb. of alfalfa silage was found to be as effective as 19 lb.

of alfalfa hay in supplementing the bluegrass pasture during the midsummer months. [D. S. A.]

JARL, F. Metodik vid ensileringsförsök. [**Technique in ensiling trials.**] *Beretn. Nord. JordbrForsk.* 7 Congress, Oslo 1. 284-96. 1947. **753**

The subject is dealt with under the following headings: technique in ensiling trials without digestibility trials, technique in ensiling trials in connexion with digestibility trials; necessary analyses, etc., calculation of experimental results, etc.

JARL, F. Resultat av utfodringsförsök med nötkreatur och ensileringsförsök. [**Results of feeding trials with cattle and ensiling experiments.**] *Lantm. Svenskt Land* 32. 372-4 and 384-96. 1948. **754**

Ensiling trials conducted recently at the Animal Husbandry Experiment Station are reviewed. In these trials comparisons were made between the AIV method and the cold fermentation method: between the addition of AIV solution and molasses; between the addition of AIV solution and formic acid: and between the addition of AIV solution and whey. Results of digestibility trials conducted at Flahult Experiment Station with silage prepared from sweet lupin green fodder harvested in three different stages are reported.

JOHNSON, B. C., ELVEHJEM, C. A., and PETERSON, W. H. **The content of grass-juice factor in legume silages and in milk produced therefrom.** *J. Dairy Sci.* 24. 861-4. 1941. [Dept. Biochem., Coll. Agric., Univ. Wisconsin, Madison] **755**

The silages consisted of the following fodders: *Medicago, Trifolium* + *Phleum, Avena* + *Pisum, Glycine* and *Andropogon sorghum* var. *Sudanensis*. The grass-juice factor can be preserved in silage, but the extent of preservation varies with method of ensiling.

JOHNSON, B. C., and PETERSON, W. H. **The transmission of carotenoid pigments from silage rations into the milk of the cow.** *Abstr. Pap. Amer. chem. Soc.* 1940. pp. 16B-17B. [Univ. Wisconsin] **756**

Ensiling green fodder with mineral acids produces carotenoid pigments which, although they have no vitamin A activity, are transferred by the cow to her butterfat. Groups of cows were fed on phosphoric acid alfalfa silage, molasses alfalfa silage, and pasture. The butterfats produced were examined chromatographically and the pigments determined as β-carotene using a photoelectric colorimeter and a 440 mμ filter. The pigments in the butterfat produced on the phosphoric acid silage were 62 per cent β-carotene, 12 per cent epiphasic (acid-formed) and 26 per cent hypophasic (xanthophyll).

The percentage distribution when the molasses silage was fed was 70, 00 and 30; when pasture was fed, 80.5 0, 19.5. In a few instances butterfat produced when molasses silage was fed contained some acid-formed pigments. The pigments were identified by their positions on the chromatogram and by their absorption bands [D. S. A.]

JOHNSON, B. C., and PETERSON, W. H. **The effect of feeding pea vine silage on the carotene and vitamin A content of milk.** *J. Dairy Sci.* 23. 385-9. 1940. [Wisconsin Agric. Expt. Sta. Madison] **757**

The feed resulted in milk with a higher carotene and vitamin A content when compared with that obtained with a dry ration.

JOHNSON, B. C., PETERSON, W. H., and STEENBOCK, H. **Butterfat and silage carotenoids.** *J. Dairy Sci.* 24. 813-7. 1941. **758**

Butters were made during the winter from the milk of two groups of cows fed respectively on phosphoric acid alfalfa silage and molasses alfalfa silage, and compared with butters produced on summer pastures. [D. S. A.]

KAEMPFE, E. [**Effect of silage acidified with HCl and H_2SO_4 on nitrogen, calcium, and phosphorus metabolism of sheep and pigs, with special reference to growing animals in long period experiments.**] *Biederm. Zbl. B. Tierernähr.* 7. 290-316. 1935. **759**

Feeding experiments with 6 months old wethers lasting 179 days and coupled with digestibility and balance experiments, comparing silage, prepared by cold fermentation with sugar and by cold fermentation with HCl, showed no differences in appetite, liveweight gains or N, Ca or P balances. The pH values of the urine of the sheep receiving the acid silage were considerably lower than those of the other group and a marked increase in urinary Ca was shown.

Similar experiments with pigs comparing potato flocks and potatoes fermented with and without sulphuric acid, as a part of the fattening ration, showed a rather better gain in weight by the pigs receiving the acid silage, although there was disturbance of appetite and some digestive trouble. Again there was no marked effect on the balances and the urinary pH was lowered but without definite increase in urinary Ca.

A further trial with adult sheep using clover/grass silage prepared with different additions of acid is similarly recorded. [N. A. and R.]

KING, W. A. **Balance studies in milking cows fed molasses grass silages and phosphoric acid grass silages.** *J. Dairy Sci.* 26. 732-3. 1943. [A.E.S., N. Jersey] **760**

The nitrogen, calcium and phosphorus balances of cows fed molasses alfalfa and phosphoric acid alfalfa silages and molasses oat and phosphoric acid oat silages were studied.

The oats were ensiled with 60 lb. of molasses and with 20 lb. of 68 per cent phosphoric acid. Twelve trials were conducted; in some no supplements were given, in others the silages were fed with other feeds. In the case of the acid silages the retention or otherwise of the Ca and/or P was dependent on the supplements fed but in the case of the molasses-preserved silages all but a few cows were in positive Ca and P balance. In only 3 out of the 12 trials did the cows show negative N balances. [From D. S. A.]

KING, W. A., PATRIAS, G. C., and RUSSELL, W. C. **The value of molasses and phosphoric acid-alfalfa silages in the rations of dairy cows.** [Abstract only.] *J. anim. Sci.* 1. 67-8. 1942. [Rutgers Univ.] **761**

Molasses-alfalfa and phosphoric acid-alfalfa silages were fed alone to 2 groups of 3 cows each in a continuous feeding trial. Limestone, sufficient to neutralize one hydrogen of the phosphoric acid, was fed for a period of 28 days to the group receiving the acid silage alone. Digestibility trials and balance studies of nitrogen, calcium and phosphorus were run several times throughout the feeding trial. Similar studies were made on two more groups of cows fed the two silages supplemented with hay and grain.

A very significant difference was found in the nitrogen balances of all cows according to the method of analysis of the silage. When corrections were made for the volatile acids and bases lost upon drying the silages, and nitrogen determinations were made on the wet samples of silage and faeces, the daily nitrogen balance changed as much as 29 grm. All nitrogen analyses were run on both wet and air-dried samples. These results definitely show that all nitrogen determinations of silages and faeces should be made on the wet sample and that volatile acids lost upon drying should be accounted for.

With the exception of one period, all the calcium and phosphorus values were negative with the cows fed the phosphoric acid-alfalfa silage even when 150 grm. of limestone were fed daily. The cows received 4 times more phosphorus and 6 times more calcium than their calculated requirement. On the other hand the balances were all positive, with the exception of one cow, when molasses-alfalfa silage was fed, in spite of a much lower phosphorus intake.

A comparison of digestibility values for the silages when fed alone and when supplemented wtih hay and grain show only small differences between the two methods with the alfalfa silages under investigation.

KIRSCH, W. [**The effects of feeding silage on nitrogen and mineral metabolism with special reference to acidulated silage.**] *Landw. VersSta.* 123. 82-7. 1935. **762**

KIRSCH, W. [**Use of HCl in silage making and its effect on the animal body.**] *Züchtungskunde* 10. 48-55. 1935. **763**

Small quantities of mineral acid ensure good conservation. Appetite, yield and weight increase in sheep, cattle and pigs are not impaired by moderate quantities of acid but with large additions N, Ca and P metabolism are adversely affected. Silage made with HCl caused increased excretion of Ca in ruminants. This effect on the calcium balance may be counterbalanced by feeding Ca or fresh fodder. [N. A. and R.]

KIRSCH. Zeitfragen neuzeitlicher Schweinefütterung und Gärfutterbereitung. [**Modern pig feeding and silage making.**] *Z. Schweinez.* 51. 73-5. 1944. **764**

This article, written in the form of question and answer, deals briefly with certain practical aspects of feeding sugar or fodder beet to pigs and the precautions to be observed. In the second part short explanations are given of the process for ensiling beets with potatoes, with green fodder, or with preservatives, and the results of a feeding trial with these different types of silage as fed to pigs are recorded. Finally, the ensiling of green fodder with potatoes, or alone, or in admixture with potatoes and beets is discussed. [N. A. and R.]

KIRSCH, W., and GRAMATZKI, F. Der Einfluss von angesäuertem Gärfutter auf den Stoffwechsel von Schafen und Schweinen mit besonderer Berücksichtigung der H_2SO_4 als Ansäuerungsmittel. [**Effect of acid silage on the metabolism of sheep and pigs with special reference to H_2SO_4 as acidifying agent.**] *Z. Zücht. B.* 36. 101-7. 1936. **765**

A wether received for 9 days grass and clover silage to which 0.5 per cent of sugar had been added. In a second 9-day period the sugar was replaced by H_2SO_4 (10 equivalents per 100 kg. of fodder) and 5 g. of $CaCO_3$ were given daily. The digestibilities and the starch equivalents of the rations did not differ and substitution of acid for sugar produced only slight alterations in the N, Ca and P balances. With the same wether it was shown that the addition of about 10 equivalents of H_2SO_4 or of HCl per 100 kg. to a ration of clover silage, clover hay, sliced sugar beet and concentrated fodder increased the feeding value by the same amount as the addition of 0.5 per cent of sugar. Positive N, P, and Ca balances resulted from giving these rations. It was also shown with a boar that the nutritive value of a ration consisting of potatoes, fish and meat meal and

crushed barley, after addition of mixtures of HCl and H_2SO_4 with and without Ca phosphate was the same as that of the same ration with addition of 0.5 per cent of sugar. High positive Ca and P balances were produced by these rations and high positive N balances when no Ca phosphate was added. When it was added the N balances were negative. [N. A. and R.]

KIRSCH, W., and JANTZON, H. [**Value of protein degradation products in silage for the nitrogen metabolism of milch cows and wethers.**] *Futterkonservierung* 4. 79-92. 1933. **766**

KIRSCH, W., and JANTZON, H. Der Einfluss künstlicher Trocknung auf den Futterwert von eingesäuerten Rübenblättern. [**Effect of artificial drying on the feeding value of ensiled beet leaves.**] *Z. Tierernähr. Futtermittelk.* 3. 120-4. 1940. [Tierzuchtinst., Univ. Königsberg] **767**

Beet leaf silage was carefully dried in a kiln and the digestibility of the resulting material compared with that of the fresh silage using a sheep as the experimental animal. The results showed a drop of 10 per cent in the digestibility of the crude protein, fat and crude fibre and of 4.5 per cent in that of the N-free extractives. Thus, on a dry matter basis, there was a fall of 10.7 per cent in the digestible crude protein and of 12.7 per cent in the starch value and a rise of 20.2 per cent in the ballast value. [N. A. and R.]

KIRSCH, W., and JANTZON, H. Einsäuerungsgemische von Kartoffeln und Leguminosen (Stoppelklee und Ackerbohnen) und ihr Futterwert für das Schwein. [**Silage mixtures of potatoes and legumes (clover and beans) and their feeding value for pigs.**] *Z. Tierernähr. Futtermittelk.* 4. 284-91. 1940. [Tierzuchtinst., Univ. Königsberg] **768**

The composition and digestibilities of silage prepared from cooked potatoes and red clover mixed in the proportion of 7 : 3 and from cooked potatoes and field beans mixed in the proportion of 5 : 1 were estimated in two trials with a single pig. The potato and red clover silage, in spite of its higher protein content, was found to be less digestible, 78 per cent as compared with 92 per cent for potato silage. Its increased crude fibre content is blamed for the lowered digestibility. The digestibility of the potato and beans silage was 88 per cent, and the net gain in digestible protein was not great. [N. A. and R.]

KNODT, C. B., SHAW, J. C., and WHITE, G. C. **Studies on ketosis in dairy cattle. 1. Effect of stall and pasture feeding upon the concentration of blood and urinary acetone bodies of dairy cattle.** *J. Dairy Sci.* 25. 837-49. 1942. **769**

KOLPAKOW, A. W., and FRÜHAUF, F. A. O stimulirujuschtschem deistwü silosowannych kormow na pischtschewariteljnye prozessy u s-ch. jiuvotnych. [**Stimulating action of silage on the digestive processes of domestic animals.**] *Probl. zivotnovodstvo, Moscow* 1936. 5. No. 8. 129-34. *Forschungsdienst.* 3. 170R. 1937. **770**

In pigs, feeding normal amounts of fermented fodder (vetch and oats containing 2.34 per cent of acid) had a stimulating effect on the digestion of cellulose. No such effect was observed in cattle probably because the digestive tract normally contains an excess of micro-organisms which degrade cellulose.

KOROLJEW, A. N., and WLASOW, J. A. Wlijanije kormlenija silosom is klewernoj otawy na katschestur gollandskogo syra. [**Effect on quality of cheese of feeding second-cut clover silage to cows.**] *Arb. Inst. Milchwirtsch. Wologda.* Bull. No. 81. 121-37. *Forschungsdienst* 3. 20R. 1937. **771**

The bacterial content was lower and its keeping quality better when silage was given than when the ration contained no silage [N. A. and R.]

KOUKL, J., and JIRÁSEK, F. Stratvitelnost a výživnost slunečnicové siláže. [**Digestibility and nutritive value of sunflower silage.**] *Zeměd. Arch.* 29. 134-43. [German, French, and English summaries. 141-3.] 1938. **772**

Feeding experiments with silage of giant sunflower (*Helianthus*) carried out on wethers at the Liblice Agricultural Experiment Station have shown that the sunflower silage contains more digestible protein (4.19 per cent) and less starch units (47.7) than maize silage (2.46 and 49.19 respectively). With the exception of fibre all nutrients of sunflower silage are highly digestible and the forage is readily taken. Detailed data on the feed ratios and experimental nutrients of sunflower silage are highly digestible and the forage is readily taken. Detailed data on the feed ratios and experimental results are given.

KRAUSS, W. E., and WASHBURN, R. G. **Studies on AIV silage. 3. Carotene preservation and biological properties of the milk.** *J. Dairy Sci.* 19. 454-56. 1936. **773**

KRONACHER, C., and KLIESCH, J. Die Eignung von Süsslupinensilage als Milchviehfutter. [**The suitability of sweet lupin silage for feeding milch cows.**] *Züchtungskunde* 9. 249-53. 1934. **774**

Sweet lupin silage was found to constitute a complete fodder for dairy cows, and to be irreproachable in its effect both upon milk production and health of the animals. The relatively high true protein content of the silage (approximately 1.5 per cent) permitted saving in the daily ration of concentrates.

KRONACHER, C., KLIESCH, J., and BUCHHOLTZ, A. Schweinemastversuche unter Verwendung von Luzernesilage, grüner Luzerne und grünem Klee. [**Pig fattening experiments with lucerne silage, green lucerne and green clover.**] *Z. Zücht. B.* 30. 229-40. 1934. **775**

Four experiments on, in all, 94 animals were carried out. The controls were fattened on potatoes with 1 kg. concentrate mixture containing 30 per cent of protein-rich feeding stuffs. The experimental animals from weaning were given increasing quantities of young green clover, green lucerne or lucerne silage, up to 2.5 kg. per head daily, in addition to steamed potatoes. Up to the 7th week of fattening, the animals were given 1 kg. of the same concentrate mixture as the controls: thereafter they had only 0.5 kg. concentrates, the protein content being increased by 50 per cent. Fattening time was somewhat prolonged in the experimental animals but total concentrate consumption was considerably reduced so that the cost of fattening was reduced. There was no difference in carcase quality. [N. A. and R.]

KUCHLER, L. F. Neuere Erfahrungen auf dem Gebiete der Futterkonservierung und der Silowirtschaft in Bayern. [**Recent experiences in fodder conservation and ensilage in Bavaria.**] *Rep. 3rd Grassl. Conf. Zürich.* 1934. 419-27. **776**

Results have been generally successful. The manufacture of hard cheese of the Emmental type, judged by experts as "good" and "very good," from the milk of silage-fed cows is reported.

LEPARD, O. L., PAGÉ, E., MAYNARD, L. A., RASMUSSEN, R. A., and SAVAGE, E. S. **The effect of phosphoric acid silage on the acid-base balance in dairy cows.** *J. Dairy Sci.* 23. 1013-22. 1940. [Dept. Anim. Husb., Cornell Univ., Ithaca] **777**

When molasses silage was replaced by phosphoric acid silage, prepared by the addition of 27 lb. of 68 per cent H_3PO_4 per ton of green material in a ration containing grain and supplemented with either hay or limestone, there was no change in the blood or urine of cows. When, however, phosphoric acid grass silage was fed alone, there were marked urinary changes indicative of acidosis but there was no change in the alkali reserve of the blood. The majority of the animals were unthrifty. When hay or limestone or both were added to the ration the urinary values returned to normal and the condition of the animals improved markedly. [N. A. and R.]

LEPARD, O. L., and SAVAGE, E. S. **The feeding value of grass silage in the ration for dairy cows.** *J. Dairy Sci.* 24. 549-60. 1941. [New Jersey Agric. Expt. Sta. (O.L.L.) and Cornell Univ., Ithaca, N.Y. (E.S.S.)] **778**

The silage was composed of grass, clover and alfalfa in the experiments designed to compare silage preserved with phosphoric acid with that preserved with molasses, and to determine their value in replacing various amounts of corn silage and dry hay.

LISKUN, E. F., and IVANOVA, G. O. [**The rationalization of feeding high-yielding cows.**] *Doklady Vsesojuz. Akad. S.-H. Nauk.* No. 3. 3-4. 1943. **779**

A high ratio of concentrate feed (87-89 feed units in total ration) is not essential in the diet of high-yielding cows. It is possible to maintain high milk yields on a diet consisting of medium quality hay, sunflower silage and a small amount of concentrates.

LUSH, R. H. **Sweet potatoes versus silage for milk production.** *J. Dairy Sci.* 19. 460-1. 1936. **780**

LÜTHGE, H. Sauerblatt und Silage in der Wirtschaftsmast der Schweine. [**Silage in economic pig fattening.**] *Z. Schweinez.* 42. 698-9. 1935. **781**

LYONS, M. **Comparison of oat silage and of Atlas sorgo silage for dairy cows.** Arkansas Agric. Exp. Sta. Annual Report 1937-38. p. 59. 1938. [Fayetteville, Ark.] **782**

In an experiment on 8 cows over a period of 28 days Atlas sorgo silage proved slightly better than oat silage for milk production. The fat content of the milk was not affected. [D. S. A.]

MACCURDY, R. D., and TROUT, G. M. **The effect of holder and flash pasteurization on some flavours of milk. II. The effect on corn and alfalfa silage flavours.** *J. Dairy Sci.* 23. 843-60. 1940. [Agric. Exp. Sta., East Lansing, Mich.] **783**

Alfalfa silage and corn silage in amounts varying from 1 to 35 lb. were fed to a Holstein cow one hour before milking. Portions of the milk were holder-pasteurized at 143°F. for 30 min. without aeration, and with aeration by stirring and by passing air up through the milk. This exhaust air was passed into a sample of cold normal milk. Portions of the milk were also holder-pasteurized under partial vacuum, and flash-pasteurized at 160°F. for 15 sec. without aeration. The intensity of feed flavour was given a numerical rating by dividing the lb. of silage fed by the lb. of milk produced. When a given amount of silage was fed to each of a group of cows of varying yield, the intensity of feed flavour in the milk varied with the yield, and was greatest in the cows of lowest yield. Feed flavour could first be detected when the cow received 0.79 lb. of corn silage, or 0.40 lb. of alfalfa silage, per lb. of milk produced. This flavour was susceptible to removal by aeration, and could be imparted in this way to normal

milk. Pasteurization lessened the intensity of the flavours but strong flavours could not be entirely eliminated. Vacuum and forced aeration holder-pasteurization were more effective than the unaerated holder or flash-pasteurization. [D. S. A.

MARTIN, J., and REYNTENS, N. Onderzoek naar de gesnaagdheid en de voedingswaarde van praktijk kuilvoeders. **Study of the quality and nutritive value of farm silage.** *Meded. Landbouwhogeschool Gent.* 10. 236-37. [French, German and English summaries. 266.] 1942. **784**

The nutritive value of 116 samples of silage was examined. The material largely comprised grass and clover. In many cases poor quality resulted as a consequence of using over ripe crops.

MARTIN, W. H., CAULFIELD, W. J., BECK, G. H., NELSON, P. F., FOLTZ, V. D., WHITNAH, C. H., and PARSONS, F. I. **The effect of various feeds and feeding practices on the flavours of milk.** Kansas Agric. Exp. Sta. Biennial Report 1938-1940. p. 86. [Manhattan, Kansas] **785**

Two groups of 3 cows were used in a number of feeding trials with pasture crops and weeds, each trial consisting of six two-day periods. With sweet clover and brome grass pasture there was a less pronounced off-flavour than with rye, winter wheat, barley and mixed cereal pastures, and shortening the time between removing cows from pasture and milking had little effect. Shepherd's purse feeding produced a noticeable off flavour. Fan weed produced no serious defects. Feeding hay and silage before putting the cows on pasture seemed to lessen the production of off flavours. There were considerable variations in intensity of flavour in the milk from different cows. [D. S. A.]

MARYLAND Agricultural Experiment Station Bull. A13. **Soybean-millet molasses silage for dairy cows.** By *M. H. Berry* and *A. L. Turk*. 1942. pp. 351-60. **786**

The nutritive value of soybean millet molasses silage was compared with that of maize silage in two feeding trials in two consecutive years. The double reversal method was employed with 20 and 16 milking cows, respectively. The soybean millet mixture was harvested when the bean pods were well filled and the millet fairly mature, and ensiled with 30 and 50 lb. of molasses, respectively [per ton of green material]. The soybean millet silage contained 69.7 per cent of moisture, 3.4 per cent of protein, 0.9 per cent of fat, 13.0 per cent of nitrogen-free extract, 9.6 per cent of fibre and 3.4 per cent of ash. It was fed at the rate of 3 lb. for each 100 lb. of live weight. No significant difference in milk production in favour of either silage was observed. The palatability of the maize silage

was better, and the cows receiving it maintained their live weight better. The flavour of the milk was not affected by feeding either of the silages. The yield per acre of soybean-millet mixture is much lower than that of maize, hence there seems little justification for growing the mixture in place of maize. [D. S. A.]

MERGNER, H. **The influence of silage on the adaptability of milk for making cheese.** *Dent. Molkerei-Ztg.* 55. 1344-6. 1934. **787**

MITCHELL, J. H., and LEASE, E. J. **A study of the factors influencing the carotene content of feeds in the South Carolina : feeding tests with cows.** South Carolina Agric. Exp. Sta. Annual Report 1938-1939. p. 81. [Clemson, S. Carolina] **788**

Four groups of cows, each containing one Jersey and one Holstein, were fed for 4 months on corn-soybean silage from a cylindrical silo and hay, the same silage alone, similar silage from a box silo, and sorghum-soybean silage from a box silo. [D. S. A.]

MITCHELL, J. H., and WISE, G. H. **The effect of corn silage and of corn and soybean silage on the carotene content of the milk of dairy cows.** South Carolina Agric. Exp. Sta. Annual Report 1942-1943. pp. 65-6. 1944. [Clemson, S. Carolina] **789**

The carotene content of fortnightly samples of the milk of mixed groups of Jersey and Guernsey cows was analysed during feeding regimes of maize silage and maize-soybean silage in a double reversal trial [see preceding abstract]. The carotene contents of the two respective fodders were 4.46 and 5.47 mg. per 100 g., but these differences were not reflected in the milks, which tended to decline in carotene content throughout the 18 weeks of the trial. [D. S. A.]

MØLLGAARD, H., and THORBEK, G. Über den Nährwert des AIV-Futters und dessen Beeinflussung durch die Neutralitätsregulation der gefütterten Tiere. [**Nutritive value of AIV fodder. Effect of neutralization of the fodder.**] *Biederm. Zbl. B. Tierernähr.* 10. 105-21. 1938. **790**

In energy balance experiments with dry cows it was found that the net energy of AIV lucerne silage decreased with increasing acidity. Neutralization with $CaCO_3$ or $NaHCO_3$ before feeding caused a lowering of digestibility. Neutralization by feeding along with mangolds did not have this effect, but on the contrary rather tended to increase the net energy. Data are also given for the digestibility and net energy of lucerne dried artificially by two processes and of lucerne hay. [N. A. and R.]

MØLLGAARD, H., and THORBEK, G. Bestemmelse af næringsvædien i AIV-lucerne. [**Estimation of the nutritive values of AIV lucerne silage.**] *Beretn. Forsøglsab., København.* No. 196. 1941. pp. 39. **791**

AIV lucerne silage which had not been neutralized had a very low nutritive value, because the resulting acidosis led to a great increase in the heat production of the organism. The heat emitted rose to about 84 per cent of the metabolisable energy, with resulting fall in the energy gained. The nutritive value rose on partial neutralization with $CaCO_3$. With complete neutralisation with $NaHCO_3$ when acidosis was prevented, the nutritive value amounted to about 76 per cent of the metabolisable energy, and the heat emitted showed a corresponding fall. When the silage was completely neutralized by $NaHCO_3$, however, the digestibility and hence the metabolisable energy per kg. dry matter of the silage fell to such an extent that the loss was not made up by the gain in utilization of the metabolisable energy.

If 6 kg. of mangolds per kg. dry matter of silage were added to the fodder, acidosis was prevented without any fall in digestibility. In this case the net energy amounted to 79 per cent of the metabolisable energy. The nutritive value per kg. dry matter reached a maximum of 1865 net calories for fattening per kg. dry matter or nearly the same as the nutritive value of 1 kg. dry matter of barley. This was true only if the silage was well preserved. The digestibility of inferior silage was low even if it was well neutralized. Although there was no acidosis, the heat emitted increased considerably, with resulting fall in the energy gained. [N. A. and R.]

MONROE, C. F., HAYDEN, C. C., PERKINS, A. E., KRAUSS, W. E., KNOOP, C. E., and WASHBURN, R. G. **Feeding value of hay crop silage.** *Bi-m. Bull. Ohio agric. Exp. Sta.* 23. 155-64. 1938. **792**

MONROE, C. F., PERKINS, A. E., KNOOP C. E., and THOMAS, R. C. **The comparative feeding value of corn silage and of corn-treated meadow crop silages, with and without addition of dilute acetic acid.** *J. Dairy Sci.* 30. 570. 1947. [St. Univ. Colombus, Ohio] **793**

In a double-reversal feeding trial of three 35-day periods maize silage, meadow silage containing maize, and meadow silage containing maize and acetic acid were fed in six different sequences to groups of 3 cows. The yields of 4 per cent fat-corrected milk based on a 28-day period were 777.4 lb., 777.9 lb. and 776.5 lb. per cow for the three silages. The meadow silages contained 2 to 3 times as much carotene and vitamin A as the maize silage. This difference was less apparent in the milks, probably because of the shortness of the feeding period. [D. S. A.]

MORRISON, F. B. **Feeding value of canning-factory silage.** *Canner* 79. 14-16. 1934. **794**

Data for sweet maize and pea silage are given. [N. A. and R.]

MÜLLER, R. Untersuchungen über den Eiweisswert von Luzernesilage. Ein Beitrag zur Frage der Eiweiss- und Amidverwertung beim Wiederkäuer. [**Studies of the protein value of lucerne silage. Protein and amide utilization in ruminants.**] *Z. Tierz. Zücht Biol.* 49. 279-305. 1941. [Inst. Anat. Haussäugetiere, Univ. Bonn] **795**

A review of the literature points to a lack of definite knowledge on the extent to which N.P.N. is utilized by ruminants. Suitable conditions in the rumen for bacterial synthesis of protein appear to be essential. The importance is stressed of providing basal rations containing sufficient protein to cover the minimum requirement for maintenance of the experimental animals ; otherwise depression of appetite and other physiological disorders will upset the experimental procedure. Evidence is brought forward to show that the usual N balance trials might lead to false conclusions by failing to take into account various sources of N loss.

Results of N balance experiments with 6 wethers are reported. The animals received a maintenance diet supplying 410 g. of protein daily per 100 kg. bodyweight, and lucerne silage. Two lots of lucerne silage were given, varying widely in quality. The bad sample depressed appetite and resulted in bad utilization of the silage, while the results with the good sample pointed to good utilization of the N.P.N. of the silage ; 65 per cent of the crude protein of the lucerne silage consisted of N.P.N. Feeding experiments with 4 older wethers confirmed the value of the good quality lucerne silage as established by the balance trials. [N. A. and R.]

NEBRASKA Agricultural Experiment Station Res. Bull. 101. **The vitamin A content of soybean silage and of AIV molasses, and common corn silages, and the effect of feeding these materials upon the vitamin A content of milk.** By *I. L. Hathaway, H. P. Davis* and *J. D. Brauer*. 1938. pp. 14. **796**

By feeding different types of silage to vitamin A deficient rats it was found that the relative vitamin A potencies were in the order ; AIV, molasses, ordinary and soybean silage. The first three of these silages were fed as the only source of roughage to cows and the relative vitamin A potencies of the milks determined by rat experiments. The potencies of the milk were found to be in the same order as those of the silages themselves. A milk of higher vitamin A potency could be produced by feeding alfalfa to cows. [D. S. A.]

NEVENS, W. B., and HARSHBARGER, K. E. **Broomcorn silage for dairy cattle.** *J. Dairy Sci.* 23. 1023-9. 1940. [A.E.S., Urbana, Illinois] **797**

Analytical data are given for silage made from broomcorn at various stages of maturity. Ensiling with molasses at the brush

harvest stage gave the best results. Two groups of 4 cows each were used in a double reversal feeding trial to compare the silage with corn silages as part of a mixed ration. Four-week periods, with one-week preliminary and transition periods were used. The daily ration of silage was 21 lb. of broomcorn or 24 lb. of corn silage ; the cows did not like the broomcorn silage as well as the corn silage. Average daily yields of 4 per cent milk energy were 34.4 and 35.4 lb. respectively on broomcorn and on corn. [D. S. A.]

NEW JERSEY Agricultural Experiment Station. Bull. 620. **A study of the factors affecting the colour of Guernsey milk with the Pfund colour grader and the wood colourimeter.** By *H. H. Tucker, J. W. Bartlett, A. S. Fox* and *K. O. Pfau.* 1936. **798**

NEW JERSEY Agricultural Experiment Station Bull. 695. **Feeding grass silage.** By *C. B. Bender.* 1942. pp. 8. [N. Brunswick, N.J.] **799**

A popular account of the value of silage made from grasses, legumes or young cereals includes brief reports of feeding trials with milking cows and dairy heifers. These silages successfully replaced maize silage. [D. S. A.]

NEW JERSEY Agricultural Experiment Station. Bull. 704. **Comparison of molasses alfalfa silage and phosphoric acid-alfalfa silage as feeds for the milking cow.** By *W. A. King.* 1943. pp. 35. **800**

Feeding studies on milking cows showed that molasses is better than phosphoric acid for preserving alfalfa silage. The molasses/alfalfa silage proved to be a very palatable and economical feed, and in digestibility was equal to the phosphoric acid-preserved silage. Maintenance of milk production and weight showed that the protein of the alfalfa silages was adequate for dairy cows without the addition of protein concentrates in the ration.

NEW JERSEY Agricultural Experiment Station. Bull. 708. **Comparison of molasses-oat silage and phosphoric acid-oat silage as feeds for the milking cow.** By *W. A. King.* 1944. pp. 22. **801**

Three groups, each of 3 Holstein and 2 Guernsey cows, were fed mixed hay and a grain mixture for 18 weeks. In addition each group received maize silage, molasses oat silage or phosphoric acid oat silage. The group receiving molasses oat silage gave 1.89 lb. of 3 per cent fat-corrected milk per lb. of total digestible nutrients compared with 1.76 and 1.74 lb. for the other groups. Two groups, each of 3 Holstein cows, were fed molasses oat silage or phosphoric acid oat silage as an exlusive diet for 11 weeks. They produced 1.55 and 1.62 lb. of 4 per cent fat-corrected milk per lb. of total digestible nutrients. Palatability was greatest for maize silage and

least for the phosphoric acid silage, though addition of a neutralizer to the latter made it as palatable as the molasses silage as part of a mixed ration only. The acid silage caused acidosis and an increase in the inorganic phosphorus content of the blood plasma. [These physiological results have been reported in *J. Dairy Sci.* 26, (11), 975 (1943).] Digestibility trials with the same cows showed no differences between the molasses and acid silages except that the crude protein of the acid silage was more digestible than that of the molasses silage. This extra digestible crude protein was however of little use, as the cows receiving acid silage excreted more nitrogen in the urine. A section of the paper deals with mineral metabolism. [D. S. A.]

NEW JERSEY Agricultural Experiment Station. Bull. 710. **Effect of feeding silages on certain properties of milk.** By *O. F. Garrett* and *D. K. Bosshardt*. 1944. pp. 30. **802**

The effect on certain milk properties of feeding alfalfa, green oat or soybean silages to cows was studied in a series of experiments extending over 3 years. Three groups of cows, each consisting of 3 Holsteins and 2 Guernseys, were used. The control group received maize silage, the second group the test silage preserved with molasses, and the third group the test silage preserved with phosphoric acid or maize meal. It is shown that the yellow colour of milk, measured in lactochrometer units, was improved by feeding alfalfa silage preserved either with molasses or phosphoric acid; no colour improvement over the controls was observed when green oat or soybean silage was fed. Flavour and resistance to oxidized flavour were improved by feeding the alfalfa silages. A high correlation was found between total carotenoid pigment in the milk and the lactochrometer readings. Under similar feeding conditions the total vitamin A concentration in the milk fat was similar for Holsteins and for Guernseys. Chromatographic analyses of the milk carotenoids were carried out and the stability of these pigments under various conditions determined [see *D.S.A.*, 5, (4), 201 (1944), BOSSHARDT and GARRETT.] [D. S. A.]

NEW JERSEY Agricultural Experiment Station. Bull. 713. **Comparison of molasses-soybean silage and corn meal-soybean silage as feeds for the milking cow.** By *W. A. King*. 1944. pp. 20. **803**

The addition of corn meal to soybeans resulted in a well-preserved and palatable silage. Molasses/soybean silage was well preserved but less palatable. Soybean silages preserved by these methods were as valuable as corn silage. Apparent digestibility, metabolizable energy, and protein and mineral metabolism are also discussed.

NEW JERSEY Agricultural Experiment Station. Bull. 722. **Comparison of molasses-grass silage and ground barley-grass silage as feeds for the milking cow.** By *W. A. King*. 1945. pp. 18. **804**

The term grass silage is used to include mixed grasses and alfalfa. The feeding value of the ground barley/grass silage was significantly greater than that of the molasses/grass silage, and both silages were more valuable than corn silage. Ground barley/grass silage was well preserved, but it was less palatable than the molasses/grass silage which was equal in palatability to corn silage.

NEW JERSEY Agricultural Experiment Station. Bull. 723. **Comparison of molasses-timothy silage and ground barley-timothy silage as feeds for the milking cow.** By *W. A. King*. 1945. pp. 17 **805**

Timothy silage preserved with 200 lb. ground barley to a ton of green material contained a greater quantity of nutrients than timothy silage preserved with molasses, but a smaller quantity of nutrients than good corn silage on the dry matter basis. In the ground barley/timothy silage all the nutrients were more digestible and had a higher metabolizable energy value than in the molasses/timothy silage.

NEW MEXICO Agricultural Experiment Station. Bull. 335. **Alfalfa hay and silage for fattening lambs.** By *P. E. Neale* and *M. Koger*. 1946. pp. 18. **806**

Feeder lambs were used in trials to compare the amount and economy of gain of lambs fattened on rations containing the following roughages: maize silage and fine alfalfa hay: maize silage and coarse alfalfa hay; cottonseed hulls and fine alfalfa hay; cottonseed hulls and coarse alfalfa hay; fine alfalfa hay alone; coarse alfalfa hay alone; protein supplements with the different grades of hay fed with silage or hulls. Experimental procedure and methods of feeding are described.

From the results obtained it was concluded that under these conditions coarse hay with less than 14 per cent of crude protein and more than 32 per cent of crude fibre will probably produce too low a gain for proper fattening. Fine hay with a low protein content is a better gain producer than coarse hay of the same composition.

Since the lambs preferred to eat more of the fine hay than of the coarse, and since the fine hay was superior in composition, lower and less efficient gains were produced by the coarse hays.

A ration containing cottonseed hulls, sorghum grain, cottonseed meal, and coarse hay, and a ration of coarse hay, silage, no grain for the first 30 days, and cottonseed meal produced such low rates of gain that they should never be used in practice.

On the basis of comparative costs and results, coarse hay is recommended when grain, together with silage, is given from the start. However, if no grain is given for the first 30 days, fine hay is better than coarse, and if no silage is used, fine hay is preferable. [N. A. and R.]

NORDFELDT, S. Utfodringsförsök med ensilage av potatis, rotfrukter och rotfrukstsblast till gödsvin. [**Feeding experiments with ensiled potatoes, roots and root tops for fattening pigs.**] *Lantbrukshögsk. Husdjursförsöksanst.* No. 38. 1944. **807**

In an experiment with 6 groups, each of 8 pigs, there was no significant difference in rate of growth or quality of carcase between the controls, fed on grain and skimmed milk, and those getting potato or mixed silage to replace 40 per cent, in terms of feed units, of the grain. The 5 types of silage were, boiled potato alone, boiled potato with 50 per cent by weight of chopped turnip or fodder beet, and boiled potato with 25 per cent by weight of turnip or beet leaves. Silage feeding was stopped at a weight of about 90 kg. and the pigs were slaughtered at 125 kg. Food consumption per kg. gain in weight was least on potato and beet leaf silage and the back fat was firmest in the groups on potato or potato and leaf. [N. A. and R.]

NORDFELDT, S., JARL, F., and HELLEDAY, T. Smältbarhetsförsök och utfodringsförsök med mjölkkor. Prövning av AIV-foder, amasil-foder, m. fl. typer av ensilage, sulfat- och sulfitcellulosa, karbamid, limsoppa och s. k. trelleborgssnitsel. [**Digestibility and feeding experiments with milk cows. Tests with AIV amasil and other types of silage, sulphate and sulphite cellulose, urea, gelatine solution and so-called Trelleborg slices.**] *Lantbrukshögsk. Husdjursförsöksanst.* Rep. No. 13. 1943. pp. 56. **808**

AIV silage was made with 1 volume of AIV solution to 6 volumes of water and 6.86 litres, per 100 kg. green crop amasil silage with 90 per cent crude formic acid, 1 volume to 20 volumes of water and 4.26 litres per 100 kg. green crop, and " Miko " silage by addition of a salt mixture containing Ca, Na and P salts, 1 kg. per 100 kg. green crop, so calculated as to produce in the final product the following ratios: $CaO : P_2O_5$ 1.2, $CaO : MgO$ 8.0 and $K_2O : Na_2O$ 2.0, and mechanical compression in a silo. Ordinary silage was also used. Digestible protein was highest in the AIV silage digestibility of organic matter highest and milk yield and weight increase greatest with formic acid silage. [N. A. and R.]

NORTH CAROLINA Agricultural Experiment Station. Annual Report 1941-1942. (Research and farming.) **Sweet potato silage makes milk.** 1942. pp. 60-1. **809**

More milk and more fat was produced by 5 dairy cows receiving silage made from sweet potato vines than by a comparable group of cows receiving good grade maize silage. The sweet potato silage contained 83 per cent more carotene, 33 per cent more protein, 27 per cent less fibre and 6.8 per cent less N-free extract than the maize silage. Total digestible nutrients were 26.9 per cent ; 57.0 per cent of the protein, 70.3 per cent of the fat, 87.3 per cent of the carbohydrate and 75.3 per cent of the fibre were digested by the cows.

Normally, thousands of tons of sweet potato vines are wasted in North Carolina each year. [D. S. A.]

Olson, T. M. **Test legume-sorghum silage for dairy cows.** South Dakota Agric. Exp. Sta. Annual Report 1939-40. pp. 32-3. **810**

Two groups of eleven cows were fed corn silage and a mixed silage of alfalfa and sorghum for 30 days ; the groups were then reversed for 30 days. The change from corn silage to the mixed silage was accompanied by decreases of 1,944 lb. in milk yield and 93 lb. in fat yield ; the reverse change caused decreases of 806 lb. and 53 lb. No difference in palatability was observed. [D. S. A.]

Olson, T. M. **Legume-sorghum silage tested for milk cows.** South Dakota Agric. Exp. Sta. Annual Report 1940-1941. p. 25. [Brookings, S. Dakota] **811**

This is the second trial in which maize and sorghum-alfalfa silages were compared ; it was intended to have two 30-day feeding trials for two groups of 12 cows, but the second 30-day period was not completed. Milk and fat production were approximately the same for maize and sorghum-alfalfa-silage, but the latter did not maintain the weight of the cows as well as maize silage (loss in average weight for 12 cows over experimental period was 29.8 lb. for maize silage, and 43.7 for the mixed silage). The palatability of the sorghum-alfalfa silage is said to be inferior to that of the maize silage. [D. S. A.]

Ontario Agricultural College and Experiment Farm. Report 1937. **Molasses silage as a feed for dairy cattle.** 1938. p. 39. [Guelph, Ontario] **812**

In an experiment with milking cows it was found that silage made from green mixed hay with molasses at the rate of 52 lb. per ton could replace corn silage but not hay. [D. S. A.]

Paterson, J. B. E. **A comparison of the feeding-values of grass ensiled by the AIV-process and a ration containing mangolds and hay.** *Empire J. exp. Agric.* 3. 144-52. 1935. **813**

Aftermath grass was ensiled by the AIV process, and 40 lb. used to replace 40 lb. mangolds and 5 lb. hay in a period reversal feeding test with South Devon dairy cows. There was no change of practical significance in the milk yield or in the average percentage of butter fat, but the yellow pigment of the butter was more than doubled in the silage period. The silage was eaten readily by the younger cows but indifferently by the older ones. There was no scouring or ill effects and the live weights of the cows, which fell slightly during the control period, rose slightly during the silage period. [N. A. and R.]

PEDERSEN, A. H. Ensilagefodringens Indflydelse paa Maelkens Brugbarhed til Smør- og Ostefremstilling. [**The effect of silage feeding on the quality of milk used for making butter and cheese.**] *Aarsberetn. Forsøgsm., Kbh.* 1940-1941. Beretn. No. 31. 27-39. 1941. **814**

Milk was obtained during December to May from herds receiving 9 to 27 kg. of AIV silage per cow per day and from herds receiving no silage. Chemical and bacteriological analyses showed the silage to be of uniformly good quality. On numerous occasions butter was made by identical methods from the two types of milk. The milk was pasteurized in a plate pasteurizer and the cream was pasteurized at 90 to 95°C. in a cream pasteurizer. Three per cent of starter was added and the cream ripened for 6 hr. at 19°C., cooled to 15°C. and churned at 13 to 14°C. The wash-water temperature was 21°C. The butterfat from the silage milk had a higher iodine value and the butter was of slightly higher grade than the control butter on the average ; the difference was mainly in body, and indeed off-flavours occurred from time to time in the silage butter.

The milks were also used for making Danish Swiss cheese, the milk being pasteurized at 68 to 70°C. in a plate pasteurizer. The silage milk usually showed a lower count than the control in the raw milk but a higher count in the pasteurized milk. Coliforms were more frequent, but butyric acid bacteria were not more numerous in the silage milk. The cheeses made from the silage milk were graded lower than the control cheese. [D. S. A.]

PENNSYLVANIA Agricultural Experiment Station. Bull. 178. **Silage feeding investigations for milk production.** By *S. I. Bechdel.* 1923. pp. 24. **815**

PENNSYLVANIA Agricultural Experiment Station. Bull. 391. **The utilization of certain feeding stuffs by cattle.** By *E. B. Forbes, J. W. Bratzler* and *C. E. French.* 1940. pp. 1-14. **816**

PENNSYLVANIA Agricultural Experiment Station. Bull. 395. **Bone meal versus no bone meal: results of a long-time feeding experiment with a dairy ration consisting of timothy hay, corn silage, and concentrates.** By *S. I. Bechdel, P. S. Williams, J. F. Shigley* and *A. A. Borland*. 1940. pp. 12. **817**

PENNSYLVANIA Agricultural Experiment Station. Bull. 410. **Alfalfa-molasses silage as a roughage for fattening steers.** By *P. T. Ziegler, F. L. Bentley* and *R. C. Miller*. 1941. **818**

PENNSYLVANIA Agricultural Experiment Station. Bull. 411. **Legume silage in dairy feeding.** By *S. I. Bechdel, R. W. Stone, P. S. Williams*, and *F. R. Murdock*. 1941. 22. **819**

Results of tests made over several years of (1) limited grain feeding plus alfalfa/molasses silage, (2) comparison of alfalfa/molasses and alfalfa/phosphoric acid silage, (3) digestive disturbances due to feeding alfalfa/phosphoric acid silage, (4) comparison of alfalfa molasses and corn silage, (5) comparison of alfalfa/molasses and soybean/molasses silage, and (6) a fermentation study on alfalfa/phosphoric acid silage in comparison with alfalfa/molasses silage.

PERKINS, A. E., and MONROE, C. F. **Studies on AIV silage. 2. Nutrient preservation and physiological effects on the cow.** *J. Dairy Sci.* 19. 453-4. 1936. [Ohio A.E.S., Wooster] **820**

PETERSEN, W. E., FITCH, J. B., and ALLEN, N. N. **The relation of AIV alfalfa silage and carotene content of milk.** *J. Dairy Sci.* 20. 429-30. 1937. [Univ. Minnesota] **821**

PETERSON, W. H., *et al.* **Pea vine silage.** Wisconsin Agric. Exp. Sta. Annual Report 1938-39. Bull. 446. 1939. pp. 28-9. [Madison, Wisc.] **822**

Cows receiving pea vine silage as part of their winter ration produced milk containing more vitamin A than when the silage was replaced by alfalfa hay. [D. S. A.]

PETERSON, W. H., BIRD, H. R., and BEESON, W. M. **Chemical changes in the making of AIV alfalfa silage and nutritive qualities of milk produced therefrom.** *J. Dairy Sci.* 20. 611-23. 1937. [Coll. of Agric., Madison, Wisc.] **823**

Medicago ensiled by the AIV method showed large gains in amino and soluble nitrogen but only small increases in ammonia nitrogen. Feeding AIV alfalfa silage to dairy cows through the winter months produced a milk with 50 per cent more carotene and 40 per cent more vitamin A than milk produced on a well-balanced winter ration. Butterfat from cows on pasture contained from 50

to 100 per cent more carotene and about 30 per cent more vitamin A than butterfat produced from AIV silage. Green alfalfa fed on the same dry weight basis as AIV silage also increased the vitamin A potency of the butterfat over the AIV values.

PETERSON, W. H., BOHSTEDT, G., BAHLER, G. [P.], NIEDERMEIER, R., and STEFANIAK, J. **How good is "wartime" grass silage milk?** Wisconsin Agric. Exp. Sta. Annual Report 1941-1942, Part I. Bull. 456. (What's new in farm science), pp. 57-8. [Madison, Wisc.] **824**

Owing to the difficulty in obtaining molasses the most practical method of making grass silage is to mix corn-and-cob meal, sorghum or green maize with the grass, or else to make the silage without a preservative. Feeding trials with these war-time silages showed that the milk was about one-half as high in vitamin A and carotene as milk obtained in other years with molasses-alfalfa silage. [D.S.A.]

PETERSON, W. H., BOHSTEDT, G., BIRD, H. R., and BEESON, W. M. **The preparation and nutritive value of AIV silage for dairy cows.** *J. Dairy Sci.* 18. 63-78. 1935. [Coll. of Agric., Madison, Wisc.] **825**

Analyses of silage pepared from lucerne and soybean are given and the effects of the fodder on the carotene and vitamin A content of butter and on milk production are recorded from feeding trials.

PETERSON, W. H., MCCLUNG, L. S., and BIRD, H. R. **Some bacteriological and chemical aspects of AIV silage.** *Proc. Amer. Bacteriol.* Dec. 1934. *J. Bacteriol.* 29. 84. 1935. [Univ. Wisconsin] **826**

Samples of AIV silage prepared from alfalfa in wooden barrels which were opened at intervals of 7-10 days were examined. Under aerobic conditions they gave successively 190, 160, 66 and 9 millions of bacteria per g. silage and similar numbers in an anaerobic series. No yeast, moulds or common aerobes were found. Barrel 2 gave 2.72 per cent of volatile and 2.20 per cent of non-volatile acids on a dry matter basis. The silage contained 1.41 per cent, water soluble N and 0.80 per cent amino-N, i.e. about twice as much as in the green crop. Ammonia N had increased and represented about 6 per cent of the total N. [N. A. and R.]

PFEIFFER, G. Die Erhaltung von Grünfutter in Behältern. [**Preservation of green food in containers.**] *Biederm. Zbl. B. Tierernähr.* 13. 1-37. 1941. [Univ. Bonn] **827**

Digestibility and N balance trials of 12 days' duration were made with sheep fed exclusively on silage, the trials being supplemented by observations on dairy herds.

PURDUE UNIVERSITY, Agricultural Experiment Station. Bull. 433. **Cattle feeding 1937-1938. 1. The value of cottonseed meal in a ration of shelled corn, corn silage, and oat straw. 2. The value of a ration containing ground ear corn and shelled corn. 3. Mixed protein supplements compared to cottonseed meal.** By *J. H. Skinner* and *F. G. King*. 1938. pp. 12. [Lafayette, Ind.] **828**

1. The addition of cottonseed meal to a ration of shelled maize, maize silage and oat straw had a beneficial effect on the rate of live-weight gain and on the finish of 2-year-old cattle. Although the cost per unit of gain was slightly increased by the addition of cottonseed meal, the animals commanded a higher selling price. Both groups failed to pay for their initial cost.

2. Cattle fed on ground ear maize made more rapid gains than similar animals fed on shelled maize, but bullocks fed on a mixture of ground ear and shelled maize (5 : 4), although they made more rapid gains than those fed on shelled maize, did not develop the same finish.

3. Mixed protein supplements showed very little advantage in rate of gain or finish over cottonseed meal in a ration of shelled maize, maize silage and oat straw. The value of gains in pigs following the cattle was higher for shelled maize than for ground ear maize or for a combination of the two. [N. A. and R.]

PURDUE UNIVERSITY Agricultural Experiment Station. Bull. 500. **Atlas sorgo silage for fattening cattle.** By *F. G. King*. 1944. pp. 11. [Lafayette, Ind.] **829**

Atlas sorgo silage was compared with maize silage for fattening 2-year-old cattle in 1940 and 1941 and the silages were compared in 3 different rations. The sorgo silage was as palatable as the maize silage. In the first trial consumption of the 2 silages was similar but in the second sorgo silage was consumed in greater amounts. Rate of gain was similar in the first year but in the second year maize silage produced more rapid gains. The economy of gain was favourable to maize silage in both years and the general results suggested a better finish for the maize-fed cattle. The net financial returns also favoured the maize silage groups. [N. A. and R.]

ŘECHKA, J. Výsledky srovnávacího krmného pokusu o vlivu sušeného a silážovaného jetele na dojnost, tučnost mléka a přírůstek živé váhy dojnic. [**Effect of clover hay and clover silage on milk production, fat content of milk and increase in live weight in dairy cows. Results of feeding experiments.**] *Sborn. čsl. Akad. Zeměd.* 12. 296-303. 1937. [Inst. Anim. Biotech., State Agric. Agric. Exp. Inst., Prague] **830**

Clover silage prepared either with or without the addition of mineral acids, when fed to milk cows, resulted in a higher yield of

milk and fat, but in a lower live-weight increase, than when clover hay was fed. Ensiling the clover with mineral acids was more costly than the ordinary process but it was more profitable in that from a given weight of green material it gave a materially higher yield of silage which was richer in digestible protein. [N. A. and R.]

RICHTER, K., and BRÜGGEMANN, H. Gärfutter im Schweinestall. [**Silage for indoor pig feeding.**] *Z.Schweinez.* 43. 407-8. 1936. **831**

RICHTER, K., and HERBST, J. Der Futterwert von grünem und eingesäuertem Sudangras (*Sorghum halepense*) und die Futterwirkung bei Verfutterung an Milchkühe. [**The fodder value of green and ensiled Sudan grass and the effect of feeding it to dairy cows.**] *Landw. VersSta.* 129. 1-11. 1938. [Forschungsanst. f. Tierzucht, Kraftborn, Breslau] **832**

Digestibility coefficients for *Andropogon sorghum* var. *sudanensis* at the time of shooting, used both green and ensiled, were determined. Simultaneous feeding trials with dairy cows established the nutritive value, palatability and wholesomeness of Sudan grass both green and ensiled.

RICHTER, F., and MERGNER, H. Die Einwirkung von Silagefütterung auf die Beschaffenheit der Milch. Mit Berücksichtigung der Eignung der Silomilch für die Herstellung von Weichkäse. [**The effect of feeding silage on milk, with reference to the suitability of the milk for making soft cheese.**] *Molkereiztg, Hildesh.* 53. 80-6 and 119-24. 1939. **833**

RIVISTA DI CONIGLICOLTURA. Sili per l'alimentazione del coniglio e del nutria. [**Silage in the diet of the rabbit and nutria.**] *Riv. coniglic.* 10. No. 7. 15-17. 1938. **834**

RODENKIRCHEN, J. Zur Mykologie des Tilsiter Käses. 5. Über die Verkäsbarkeit von Silagemilch. [**Mycology of Tilsit cheese. 5. Effect of feeding silage on the suitability of the milk for cheese making.**] *Milchw. Forsch.* 19. 23-71. 1937. **835**

Contrary to earlier results, feeding experiments carried out in the winter 1935-36 showed that milk from cows consuming acid silage containing 0.37 to 0.79 per cent butyric acid was not suitable for making Tilsit cheese. Examination of the excreta from the cows showed a very much higher acid bacteria count (250,000-600,000 per g.) when the acid silage was fed than when the non-acid silage was fed (1300-1500 per g.). The high bacterial content of the excreta probably favoured contamination of the milk. The results of complete bacterial examinations of the cheeses made under the different feeding conditions are given. [N. A. and R.]

RODENKIRCHEN, J. **Cheese research with ensilage milk.** Proc. 11th World's Dairy Congress, Berlin, 2. 217-9. 1937. **836**

SANDELIN, A. E. **Effect of AIV silage on butter quality.** *Milchw. Zbl.* 65. 147-9. 1936. **837**

Observations extending over 7 years have shown that the feeding of cows with AIV silage affects neither the commercial nor the keeping quality of butter. [N. A. and R.]

SAPELKIN, N. M. [**A supplementary silage ration for sheep during the grazing period.**] [Contained in : Feeding of farm animals and fodder production.] Moscow, 1940, 106-9. [Moscow Zootech. Inst.] **838**

Experiments were carried out during 1937 and 1938 (in July-August) in a drought-susceptible region where the yield of green mass on natural pastures was reduced to 10-15 centners per ha. at that time and the air temperature in the sun rose to 50°C. In 1937, 200 wethers (100 head each in the experimental and control flocks) formed the object of experimentation. (A) Experimental wethers (100 head) received an additional ration of silage and consumed 63 kg. of it per head during a period of 30 days ; (B) 100 controls were maintained on pastures and had no silage ration. The silage was made in May from the steppe grass in which *Poa pratensis* (60 per cent) and *Bromus inermis* (25 per cent) predominated. The gain of live weight was 5.12 and 1.06 kg. in (A) and (B) groups respectively. In 1938 experiments were conducted for 40 days on 396 4-months-old ram-lambs : (C) 193 controls and (D) 203 experimental animals. The animals of group (C) were maintained on pastures without an additional silage ration and those of (D) consumed daily 600-800 grm. of silage. The average gain of live weight per head at the end of the period was 3.09 and 0.82 kg. for the groups (D) and (C) respectively.

SAVAGE, E. S., HARRISON, E. S., and RALSTON, N. P. **The nutritive value of molasses-legume-grass silage as compared with that of corn silage for milk production.** Cornell Agric. Exp. Sta. Report 1941. p. 105. [Ithaca, N.Y.] **839**

The nutritive values of maize silage and molasses-legume-grass silage were compared in a double-reversal feeding trial of 27 weeks with two groups of 7 cows each. The legume-grass mixture consisted of mixed alfalfa and red clover (60 per cent) and grasses, mainly timothy (40 per cent). The preserving molasses was added at the rate of 55 lb. to a ton of green material. The dry-matter content of the maize silage was 21.56 per cent, that of the molasses-legume-grass 27.03 per cent. Both kinds of silage were fed at the rate of 4.5 lb. per day per 100 lb. of body weight. The concentrate

mixture was fed at the rate of 1 lb. for each 3.5 lb. of fat-corrected milk, and dry mixed legume hay at the rate of ½ lb. per day per 100 lb. of body weight. There was no difference in palatability between the two types of silage, and the two groups of cows gained approximately the same amount per day in body weight. Milk yield was 29.1 against 27.6 lb. of fat-corrected milk per day in favour of the maize silage. [D. S. A.]

SCHARRER, K., and SCHREIBER, R. Untersuchungen über die Verdaulichkeit von frischer Luzerne, Luzerneheu, Luzernemehl und Luzernegärfutter an Schafen. [**Digestibility of fresh lucerne, lucerne hay, lucerne meal and lucerne silage by sheep.**] *Z. Tierernähr. Futtermittelk.* 3. 27-44. 1940. [Agrik. Chem. Inst., Univ. Giessen] **840**

The fresh lucerne, the hay and two lots of silage, one made with biosil and the other with formic acid, were all from the same crop. The lucerne meal was a commercial product. Digestibility trials gave the following respective values on a dry matter basis for the fresh lucerne, hay, meal and two lots of silage: digestible true protein 9.09, 10.78, 12.4, 6.95 and 7.52 per cent, starch equivalents 40.7, 35.4, 44.9, 22.4 and 23.9 per cent. All 4 forms of lucerne were readily eaten by the sheep. [N. A. and R.]

SCHARRER, K., and SCHREIBER, R. Ueber die Wirkung von Maisgärfutter auf Milchertrag und Milchqualität. [**Effect of maize silage on yield and quality of milk.**] *Z. Tierernähr. Futtermittelk.* 6. 55-64. 1943. [Agric. Inst., Univ., Giessen] **841**

A change-over feeding trial was carried out with 4 Black Pied Lowland cows in which the basal fodder was a mixture of meadow hay, oat straw, ground oats and soybeans, dried beet slices, wheat bran and palm kernel cake. To this was added 10 and 20 kg. of maize silage during the first and second 14-day experimental periods. With a feed of 10 kg. of maize silage the average milk yield rose from 12 to 12.48 kg., with 20 kg. of silage the average yield rose from 10.98 to 11.88 kg. Fat content was not affected. [D. S. A.]

SCHARRER, K., and SCHREIBER, R. **Ensilage of green rape with and without the addition of preservatives and digestibility trials with sheep on fresh and ensiled green rape.** *Biederm. Zbl. B. Tierernähr.* 14. 176-97. 1942. **842**

Four samples of silage were prepared from green rape: without preservative, with addition of amasil, 1½ per cent of sugar or a proprietary biological preservative. All samples on the basis of their acid content and pH values were classed as very good. Digestibility trials with sheep were made on the 4 lots of silage and the original green rape. All samples were readily eaten. All the constituents

of the green rape showed digestibility coefficients of the order of 80 per cent except the ether extract where the value was 56 per cent. There were only small differences between the silages but all showed lower digestibility coefficients for protein, fibre and N-free extractives and higher coefficients for ether extract than the original green rape. On a dry matter basis the silages showed somewhat lower starch values than the green rape. [N. A. and R.]

SCHARRER, K., and SCHREIBER, R. Über die Verdaulichkeit von gedämpften und eingesäuerten Kartoffeln bei Schafen. [**Digestibility of steamed and ensiled potatoes by sheep.**] *Biederm. Zbl. B. Tierernähr.* 14. 345-52. 1942. [Agrik. Chem. Inst., Univ. Giessen] **843**

The sample of steamed, ensiled potatoes used in the experiment had been in the silo more than a year. On the basis of its volatile acid content it was classed as good and from its pH value (3.98) as very good. It was readily eaten by sheep. [N. A. and R.]

SCHARRER, K., and SCHREIBER, R. Ueber die Wirkung von Saflor-Gärfutter auf Milchertrag und Milchqualität. [**Effect of safflower silage on yield and quality of milk.**] *Biederm. Zbl., B. Tierernähr.* 14. 417-23. 1942. [Agrik. Chem. Inst., Univ., Giessen] **844**

On evidence based on a test with four cows the authors conclude that by including 10 kg. of safflower silage in the daily ration of a cow the milk yield was depressed and the fat content increased while the fat yield remained unchanged. Details are given of the chemical composition of safflower [*Carthamus tinctorius*] and of the silage prepared from it. [D. S. A.]

SCHARRER, K., and SCHREIBER, R. Über die Verdaulichkeit von Topinamburkraut und Topinamburknollen in frischem und eingesäuertem Zustand. [**Digestibility of artichoke leaves and tubers fresh and ensiled.**] *Biederm. Zbl. B. Tierernähr.* 15. 355-86. 1943. [Agrik. Chem. Inst. Univ. Giessen] **845**

This is a report of an investigation into the food value of different types of artichoke foods. The crop yielded 265 dz. per hectare of tubers and 410 dz. per hectare of stems and leaves. The stems and leaves together were fed in the fresh state, dried as hay and ensiled with amasil as preservative. The tubers were fed in the raw state, ensiled in the raw state and ensiled after steaming. All 6 feeds were readily eaten by the sheep used in the digestibility trials. All 3 lots of silage showed good pH values, with a high percentage of lactic acid in the total acids and no butyric acid.

The tubers when made into silage, either with or without previous steaming, gave products having a food value nearly as good as that of ensiled steamed potatoes. The crop had the advantage over

potatoes that the leaves and stems gave a high yield and the food, either fresh, as hay or as silage, was readily consumed and had a reasonable food value on a dry matter basis. The relative yields of artichokes and potatoes per acre favoured the artichoke. [N. A. and R.]

SCHNEPF, F. **The influence of calcium salts and hay on the calcium and phosphorus metabolism of sheep fed with acidified silage.** *Biederm. Zbl. B. Tierernähr.* 8. 300-39. 1936. **846**

SCHNEPF, F. Weitere Untersuchungen über den Einfluss von Grünfutter, Gärfutter und Heu auf den Stoffwechsel des Wiederkäuers. [**Further studies of the effect of green fodder, silage and hay on the metabolism of the ruminant.**] *Biederm. Zbl. B. Tierernähr.* 9. 191-203. 1937. **847**

Balance experiments with 4 sheep are reported in which the rations consisted of a mixture of red clover and timothy fed either in the green state, as hay (dried on racks) or as silage made with the addition of either HCl, H_2SO_4 or sugar. N and Ca balances were determined as well as the pH of the urine and blood and the CO_2 tension of the plasma. Allowing for individual variations among the animals it would appear that the plasma CO_2 tension is as useful as the Ca balance as a measure of the suitability of a ration. The individual pH variation of the blood is too slight, and that of the urine too wide, to be of value. Hay appears to preserve the Ca balance better than the green fodder, and silage made with the addition of sugar is distinctly better in this respect than silage made with the addition of acid. [N. A. and R.]

SCHULTZ, J., AUGUSTIN, H., and FINZENHAGEN, H. Eingesäuertes Kartoffelkraut als Futter für Milchkühe. [**Potato leaf silage as a feed for dairy cows.**] *Biederm. Zbl. B. Tierernähr.* 7. 517-31. 1935. **848**

The organic matter of ensiled potato tops was found to be digested to the extent of 49 per cent by sheep ; crude protein 48 per cent ; true protein 33 per cent ; fibre 44 per cent ; N-free extractives 52 per cent. The average content of digestible crude protein was 1.06 per cent (true protein 0.55 per cent) and the starch equivalent was 4.17. Milk cows ate up to 8 kg. per head daily, but the individual consumption varied considerably. There was no detrimental effect on either health or milk yield. [N. A. and R.]

SEARS, P. D., and SILL, F. B. **The digestibility by dairy cows of a grass silage.** *N. Z. J. Sci. Tech.* 23. 50A-6A. 1941. **849**

The experiment described is one of a series of investigations dealing with nutritive value of pastures and supplementary fodders in relation to increasing the carrying capacity of pastures by the use of selected strains, suitable top dressing and improved pasture management. The herbage ensiled consisted of *Lolium perenne*, *Trifolium repens*, other grasses and other species, with the following leaf/stem ratios respectively: 1 : 3.3; 1 : 1.5; 1 : 1.4; 1 : 0.8. The figures for digestibilities of the nutrients were within the range of variation of figures for similar fodder from countries other than New Zealand.

SEARS, P. D., SILL, F. B., and NEWBOLD, R. P. **The apparent digestibility of samples of pasture silage.** *N. Z. J. Sci. Tech.* 24. 91A-5A. 1942. [Palmerston North] **850**

In New Zealand, where both dairying and sheep farming are based on a grassland system of agriculture, the importance of silage as a means of conserving surplus herbage can be readily appreciated. It is claimed that silage of a high feeding value, which could provide a valuable production ration, can be made from young succulent pasture.

Sheep not previously accustomed to silage were used to determine the apparent digestibilities of silage samples. Ensilage of young, nutritious herbage gave silage with high digestibility, but pasture at medium and mature stages of growth gave silages with lower digestibility. In all the trials the sheep maintained their weight or made slight gains. The feeding value of the final silage depends on the state of maturity and quality of the herbage and the efficiency of the ensiling methods used. It is therefore essential to maintain a high standard in both these conditions to ensure the best possible product.

SHEEHY, E. J., and DELANEY, D. **The food value of ensilage and the economy of ensiling.** *J. Dep. Lands Agric. Dubl.* 24. 117-39. 1924. **851**

In the various feeding tests conducted at Athenry, in the seasons 1922-23, and 1923-24, the weight of ensilage of equivalent food value to 10 pounds of mangels ranged from 4.7 to 6 pounds. Ensilage appeared to have a higher value when fed in moderation than when given in large quantities. In the light of these experiments 5½ pounds is a safe figure to adopt as the weight of ensilage of equivalent food value to 10 pounds of mangels.

The ration of yearling calves may safely include 21 pounds, and that of adult fattening cattle and milch cows about 42 pounds per head daily of good ensilage.

The succulence of ensilage renders it a suitable substitute for roots. On the other hand, its bulk and comparatively high proportion of dry matter prevent its use in large quantities in a ration containing a high proportion of hay, in fact ensilage more suitably fits into a ration as a substitute for the roots as well as for part of the long fodder, or for part of the roots and part of the long fodder.

The cost of production per acre of ensilage is much less than that of mangels.

Taking the yield per acre of stored mangels as 26¾ tons (the actual 1923-24 production at Athenry) and that of cured ensilage as 9 tons—a possible yield if no waste occurred in the ensilage—the total food produced per acre is less in the case of ensilage than of mangels, but assuming a 9 ton yield of ensilage the cost of producing equivalent food values of each—namely 5½ pounds of ensilage and 10 pounds of mangels—works out at the same figure, even after the cost of the blower and the expense of erecting the silo have been taken into consideration.

SOTOLA, J. **Digestion experiments with mixtures of sweet clover and Albit wheat forage ensiled and cured as hay.** *Proc. Amer. Soc. Anim. Prod.* Dec. 1936. 143-7. [Washington A.E.S.] **852**

A comparison of hay and silage from mixtures of sweet clover and Albit wheat, on the same dry matter basis, showed differences of 3.4 per cent in total digestible nutrients, 28.5 per cent in digestible protein, 18.9 per cent in digestible crude fibre and 133.3 per cent in ether extract in favour of the silage, and of 13.9 per cent in N-free extractives in favour of the hay. [N. A. and R.]

STAFFE, A. Der Einfluss des Silofutters auf Milch und Milchprodukte. [**Effect of silage on milk and milk products.**] *Wien. landw. Zeitung* 86. No. 24. 159. 1936. **853**

As regards quality of fresh milk, butter and soft cheese good silage is preferable to other fodders having equal starch values and protein contents. It has not yet been determined whether the silage can be advantageously fed for the production of hard cheese. [N. A. and R.]

STAHL, W. Über die Wirkung der Futterumstellung von frisch gedämpften auf Sauerkartoffeln. [**Effect of changing from fresh steamed to ensiled potatoes.**] *Z. Schweinez.* 42. 296-7. 1935. **854**

Two trials are described in which 4 groups of pigs, after receiving fresh steamed potatoes for 3 weeks, were suddenly changed to ensiled potatoes for a further period of 3 weeks. The sudden change resulted in a check in the amount of food consumed and live weight increase during the first week after the change, but subsequently appetite improved and growth was normal. [N. A. and R.]

STAWART, J. **Grass silage for sheep.** *J. Minist. Agric.* 56. 197-9. 1949. [Wooler, Northumberland] **855**

The author maintains that silage may replace roots in sheep feeding if a few simple rules are observed. It is important that the silage be made from short grass of good quality, and that the change from any feed to grass silage be made gradually. On the author's farm concentrates are not dispensed with entirely ; silage replaces turnips and full use is made of home-grown cereals ; 10 to 11.5 lb. of silage gives a live-weight gain or 2 to 3 lb. per sheep per week.

STEENSBERG, V., and WINTHER, J. E. Ensilage som Foder til Malkekøer. Fordøjelighedsforsøg med Roetopensilage. Ensileringsforsøg. [**Research on silage and silage making. Silage as fodder for milking cows. Digestibility of beet tops and beet-top silage. Research on methods of making silage.**] *Beretn. Forsøgslab. Kbh.* No. 202. 1942. pp. 203. [Roy. Vet. Agric. Coll., Copenhagen] **856**

Earlier work [see *Beretn. Forsøgs-lab. Kbh.*, No. 178 (1938) and earlier reports] has been continued with numerous experiments during 1934-1942. In one experiment in 1934-35 portions of a lucerne crop were made into hay, AIV silage, common silage without any addition, or artificially dried, and the products were fed to 5 groups each consisting of 8 cows at least three months from calving. There was a fore-period of 42 days, a change-over period of 14 days, an experimental period of 70 days, a change-over period of 7 days and an after-period of 28 days. The control groups received a ration of concentrates, roots, straw and 2 kg. of lucerne hay ; the experimental groups received the same number of fodder units but their rations were modified to include 8 kg. of hay, 28 kg. of AIV silage, 12 kg. of common silage or 6 kg. of dried lucerne. The hay ration and the two silage rations provided about 100 g. of crude protein more, and the two silage rations about 300 g. of true protein less than the others. All groups gave a yield of 16.5 to 16.7 kg. of fat-corrected milk during the fore-period and no greater differences were found in the experimental period when the decline in yield was 2.81 kg. of fat-corrected milk for the control group, 3.13 kg. for the hay group, 3.42 kg. for the AIV-silage group, 3.44 kg. for the common-silage group, and 2.79 kg. for the dried-lucerne group ; fat percentage declined in the AIV-silage and dried-lucerne groups but rose in the others.

In an experiment in 1935-36 AIV silage from meadow grass was compared with AIV silage from lucerne. Twenty-seven cows were divided by lot into 3 groups. All were fed alike during the fore-period ; then followed a change-over period. In the experimental period all groups received equal amounts of sugarbeet and hay but the control group received 4 kg. of straw, the second group 23.6 kg.

of meadow silage and the third group 21.4 kg. of lucerne silage ; the rations of concentrates were adjusted so that all groups had the same number of fodder units but the silage groups had 13 and 20 per cent more crude protein and 16 and 21 per cent less true protein than the control group. Yield and fat percentage were the same for the three groups during the fore-period, but during the experimental period the decline in yield of fat-corrected milk was 2.38 kg. for the control group, 1.77 kg. for the meadow-silage group and 1.98 kg. for the lucerne-silage group ; the rise in fat percentage was less for the control group than for the other groups. The total declines in milk yield from fore-period to after-period were 2.91, 2.57 and 2.68 kg.

Two experiments were carried out during 1935-37 to compare AIV silage made from beet tops with beet-top silage made, in the first experiment in a pit and in the second in a tower silo, between layers of sugarbeet wet slices. Fifty-one cows in 3 groups were used. In both experiments yield and fat percentage were the same for all groups, which were fed alike, during the fore-period. In the first experiment the fore-period of 6 weeks was followed by a change-over period of 4 weeks and an experimental period of 8 weeks during which the control group had sugarbeet, straw and concentrates, the silage groups the same ration with half the sugarbeet replaced by AIV silage or common silage to supply the same number of fodder units. The AIV silage was taken as 10.2 kg. to one unit and the common silage 11.6 kg. to one unit. Yields of 16.7 kg. of fat-corrected milk during the fore-period declined by 3.00, 3.47 and 2.83 kg. ; fat percentage increased by 0.31, 0.25 and 0.39. In the second experiment two-fifths of the sugarbeet was replaced by silage ; yields of about 18.3 kg. of fat-corrected milk declined by 2.42, 2.92 and 3.36 kg. and fat percentage increased by 0.24, 0.16 and 0.20.

During 1936-1940 seven experiments were carried out with silage made with a mixed culture of lactic acid bacteria and yeast. In 1939 bacterial-yeast silage was made in a tower silo without a drain, and contained 91 per cent of lucerne, 6 per cent of culture, 2 per cent of molasses and 1 per cent of molasses bran. Losses were high, pH reached 5 to 5.5, but the silage was highly palatable. Thirty-two cows were divided into four groups. During the fore-period of 5 weeks, yield and fat percentage were equal for all groups. This was followed, after a change-over period of 2 weeks, by an experimental period of 8 weeks when the two control groups had 3 fodder units of AIV silage and the two experimental groups 3 units of culture silage. One control group and one experimental group were allowed 4.5 fodder units with 300 g. of digestible true protein for maintenance and 0.45 fodder units with 67 or 41 g. of digestible true protein per kg. of fat-corrected milk. The second control group and the second experimental group were allowed 4.75 fodder units with 250 g. of protein for maintenance and 0.50 fodder units with 47

or 23 g. of digestible true protein per kg. of milk. Declines in yield of fat-corrected milk from the fore-period to the end of the experimental period were 4.42 kg. for the first control group, 4.56 kg. for the second control group, 3.77 kg. for the first experimental group and 5.30 kg. for the second experimental group. [D. S. A.]

STEFANIAK, J. J., RUPEL, I. W., BOHSTEDT, G., and PETERSON, W. H. **Methods of preserving grass silage and vitamin A potency of milk produced therefrom.** *J. Dairy Sci.* 30. 102-14. 1947. [Univ. Wisconsin, Madison] **857**

Preservation of grass and legume silage by addition of 200 lb. corn-and-cob meal per ton silage produced a palatable silage, but carotene preservation was not so good as when molasses was the preservative. On the basis of milk production and change in body weight, silages of corn and alfalfa were of equivalent feeding value.

STEFANIAK, J. J., RUPEL, I. W., and PETERSON, W. H. **Effect of feeding corn and alfalfa silages on the fat-and-water-soluble vitamins of winter milk.** *J. Dairy Sci.* 27. 629-30. 1944. [Univ. Wisconsin] **858**

STEINER, W. Untersuchungen über die Konservierung von Grünfutter nach dem Verfahren von A. I. Virtanen. [**Investigations on the conservation of green fodder by the AIV process.**] *Landw. VersSta.* 124. 1-86. 1935. [Eidg. Tech. Hochschule, Zürich, Switzerland] **859**

The material was as follows: May, 1933; clover species (principally *Trifolium pratense*) 65.4 per cent grasses (mainly *Dactylis glomerata*, panicles just emerging from the leaf sheaths, *Festuca pratensis*, *Avena flavescens* and *Phleum pratense*) 34.6 per cent: October, 1933; clover species (*Trifolium pratense* cut just before flowering) 64 per cent, grasses 35 per cent, miscellaneous herbs 1 per cent. Feeding trials in 1934 showed that the feeding of animals with AIV silage led to a greater consumption of fodder, which was expressed in a somewhat higher milk production, but with the greater consumption the utilization of the fodder was during the main periods unsatisfactory. No detrimental effects on the health of the animals are recorded.

STORGÅRDS, T. **Influence of nutrition on the quality of butter.** *Karjatalous* 11. 12-15. 1935. *Chem. Zbl.* 1935. 2461. **860**

Many fresh, fermented, and spoiled fodders impart undesirable flavours or odours to butter. Hard butter in winter is associated with feeding hay, oats, and soybean meal. AIV silage improves butter quality. [N. A. and R.]

STORRS Agricultural Experiment Station Bull. 198. **Corn silage feeding investigations (9th paper). The role of succulence in the dairy ration and water consumption with different rations.** By *G. C. White* and *R. E. Johnson*. 1934. pp. 35. **861**

Results indicate that when cattle receive an abundant supply of leafy forage in their rations there is no necessity for the provision of a succulent food if the animals have free access to water. The daily water intake and the amount of dry matter consumed under different systems of watering and feeding are given. [N. A. and R.]

TEXAS Agricultural Experiment Station. Bull. No. 622. **Silage and cottonseed meal for fattening yearling steers.** By *J. H. Jones, R. E. Dickson, J. K. Riggs,* and *J. M. Jones*. 1942. pp. 22. **862**

Cottonseed meal and sumac silage can be used for fattening yearling steers without the addition of grain. This is a useful feeding method when silage is abundant and grain scarce, but the gains in weight are only moderate.

TSCHERNIAK, A. Mineralsäuresilage als Geflügelfutter. [**Mineral acid silage as poultry feed.**] *Arch. Geflügelk.* 9. 255-69. 1935. *Tierwelt* 45. 1021-4. 1935. **863**

Rhode Island hens (48) were given 70 g. wheat per head daily; half of them in addition, a laying mixture *ad lib.* and the other half the laying mixture and clover silage. The nutritive ratio in both groups was roughly 1 : 3.8. The average daily consumption of silage was 47 g. per head and consumption of the laying mixture was reduced by 20 per cent. Per 100 g. egg (with shell) produced, the utilisation coefficients were 277 with, and 337 without silage. [N. A and R.]

UNITED STATES, Department of Agriculture. Tech. Bull. 649. **Relative values for milk production of hay and silage made from immature pasture herbage.** By *R. R. Graves, J. R. Dawson* and *D. V. Kopland*. 1938. pp. 31. **864**

Four Friesian cows were fed *ad lib.* throughout entire lactation periods exclusively on hay made from young grass and 4 similar animals were fed exclusively on silage made from similar material. The cows on the hay ration produced an average of 11,325 lb. of milk and 403 lb. of butterfat in 6 lactation periods (age corrected). This was about 64 per cent as much as when the same animals had previously received a normal ration of lucerne hay, maize silage, pasture and concentrates fed according to yield. The animals on the grass silage ration produced an average of 10,304 lb. of milk and 388 lb. of butter-fat in 4 lactation periods (age corrected). This was about 61 per cent as much as when the same cows were previously fed on the normal ration. The cows receiving the hay consumed an

average of 43.5 lb. per head daily and the total digestible nutrients consumed exceeded the theoretical requirements in every month of the lactation period except the first and second ; those receiving the silage consumed 91 lb. per cow daily but consumption of digestible nutrients did not exceed the theoretical requirements until the fourth month of the lactation period. The cows on both rations apparently remained in good health. Those receiving the silage exhibited breeding troubles but the same cows had previously shown similar troubles on other rations. [D. S. A.]

UNITED STATES, Department of Agriculture. Circ. 696. **Single grains and grain mixtures as supplements to alfalfa hay and silage for milk production.** By *J. R. Dawson. A. L. Watt, C. W. McIntyre, R. E. Leighton* and *R. R. Graves*. 1944. pp. 11. **865**

Co-operative experiments conducted in N. Dakota, Montana and Oklahoma showed that when cows were allowed access to as much good hay and silage as they could consume, it made little difference, as far as milk and butterfat production were concerned, whether the additional nutrients required were supplied from a single grain or from a mixture of several grains and grain by-products. [N. A. and R.]

UNITED STATES, Department of Agriculture. BDIM-Inf.-34. [Mimeographed Report] **Comparative value of wilted alfalfa silage and alfalfa hay for milk production.** By *J. B. Shepherd, R. E. Hodgson* and *W. J. Sweetman*. 1946. **866**

The method of making wilted alfalfa silage is briefly described. Its nutritive value for milk production was compared with that of alfalfa hay in four trials. A straight comparison was attempted in two of the trials with 10 and 8 pairs of cows, the third trial was a switch-over test with two groups of 6 cows, while the fourth was a double-reversal test with six groups of 3 cows each. In the first three trials the experimental periods lasted 60 days each, in the fourth trial only 30 days. Details of the quality of the alfalfa silage and the hay used in each test, their dry matter and digestible protein content, are given. The wilted silage was found at least as palatable as best quality hay, and its nutritive value for milk production was equal, if not a little [not significantly] superior, to that of alfalfa hay. [D. S. A.]

UNITED STATES, Department of Agriculture, Bureau of Dairy Industry. Report for 1944-1945. **No nutritional deficiency in milk from cows on grain and corn silage.** 1945. p. 13. **867**

Milk produced by cows fed on grain and maize silage was found to have no lower nutritive value than that of cows fed on pasture or

good alfalfa hay and calves raised on it equalled or surpassed the growth standards for their breeds at all periods up to 12 months of age. [D. S. A.]

VERMONT Agricultural Experiment Station. Bull. 482. **Feeding values of silages and hays.** By *O. M. Camburn, H. B. Ellenberger,* and *C. H. Jones.* 1942. pp. 12. **868**

Poor quality grass silage made with 3 per cent molasses added to a wet crop was compared with maize silage in a reversed feeding trial with 8 dairy cows. There was an insignificant difference in the milk yield and liveweight changes of the animals with the 2 systems of feeding. Timothy grass cut at full bloom and sun cured, artificially dried, or ensiled with molasses, was compared with maize silage in a feeding trial with 4 groups of unbred heifers. The weights of total digestible nutrients consumed per lb. of liveweight gain were 7.4, 6.8, 7.2 and 6.0 lb., respectively. In a similar trial with timothy grass grown during a rainy season and conserved as phosphoric acid silage or field cured hay, the total digestible nutrients consumed per lb. of liveweight increase were 7.0 and 8.1 lb., respectively. [N. A. and R.]

VIRGINIA Agricultural Experiment Station. Bull. 353. **The feeding value of clover-molasses silage for milking cows.** By *A. D. Pratt* and *C. W. Holdaway.* 1943. pp. 15. **869**

Feeding trials were undertaken to compare the nutritive value of clover hay and clover-molasses silage on a dry matter basis for milk production. In each trial more milk was produced per pound of dry matter from clover silage than from clover hay. The milk had a more yellow colour when cows were fed with silage than when fed with hay. Molasses or corn meal are preferred to mineral acids as preservatives as this obviates the use of limestone to neutralize the acid.

VIRTANEN, A. I. **Effect of AIV silage on the growth of young rabbits.** *Contr. Lab. Valio.* 1935. No. 2. pp. 7. [Lab. Valio, Helsinki, Finland] **870**

AIV silage (made from clover/timothy aftermath) is a palatable, nutritious, vitamin-rich fodder for young rabbits.

WASHINGTON Agricultural Experiment Station, State College. Bull. 364. **The composition and apparent digestibility of pea silage, sun cured pea vines and artificially dried pea vines.** By *R. E. Hodgson* and *J. C. Knott.* 1938. pp. 12. **871**

These by-products of the growing of peas for canning are useful additions to the regular winter feed supply for stock. On a dry matter basis they furnish the following percentages of digestible

crude protein and total digestible nutrients, respectively: silage 7.0, 57.8; sun-cured pea vines 11.5, 63.8; artificially dried pea vines 6.8, 59.4. When climatic conditions permit, sun curing will apparently give the best quality feed. [N. A. and R.]

WASHINGTON Agricultural Experiment Station Bull. 366. **The nutritive value of home grown roughage rations for dairy cattle.** By *R. E. Hodgson, J. C. Knott, V. L. Miller* and *H. K. Murer*. 1938. pp. 80. **872**

1. Composition and nutrient changes in forages during harvesting and preservation.
2. Apparent digestibility of the home-grown hay and silage rations.
3. The feeding value of the home grown roughage rations for lactating dairy cows.
4. The calcium and inorganic phosphorus in the blood of dairy cows maintained on home-grown all roughage rations.
5. The relation of colour and carotene content of roughage in the dairy ration to the colour, carotene content, and vitamin A.

WASHINGTON Agricultural Experiment Station. Bull. 386. **The feeding value of alfalfa hay compared with mixed hay and grass silage as a ration for dairy cattle.** By *R. E. Hodgson* and *J. C. Knott*. 1940. pp. 27. [Pullman, Washington] **873**

WASHINGTON Agricultural Experiment Station Bull. 444. **Grass and grass-alfalfa mixtures for beef production in eastern Washington.** By *M. E. Ensminger, H. G. McDonald, A. G. Law, E. J. Warwick, E. J. Kreizinger* and *V. B. Hawk*. 1944. pp. 24. **874**

Grass and alfalfa mixtures produced nearly three times the liveweight gain and three times as much oven-dry forage per acre as pure grass pastures during 3 seasons unusually favourable for forage production. The grass and alfalfa mixtures were ready to graze somewhat earlier in the spring and the rate of increase of available forage was higher than from pure grass mixtures. [N. A. and R.]

WATSON, S. J. **The value of silage and artificially dried grass in the feeding of the dairy cow.** *Wiss. Ber. XI. Milchw. Weltkongr. Berl.* 1. 191-6. 1937. [Jealott's Hill Res. Sta., Bracknell, England] **875**

WATSON, S. J., and FERGUSON, W. S. **The value of artificially dried grass, silage made with added molasses and AIV fodder in the diet of the dairy cow and their effect on the quality of the milk, with special reference to the value of the non-protein nitrogen.** *J. agric. Sci.* 26. 337-67. 1936. [I.C.I. Ltd., Jealott's Hill Res. Sta., Bracknell, Berks.] **876**

Artificially dried grass, molassed silage or AIV fodder supplied approximately half the total digestible crude protein in the three experimental rations. The control ration consisted of hay, roots and concentrates. The N.P.N. of the molassed silage supplied 32 per cent of the total digestible crude protein intake whilst in the AIV fodder it supplied 25 per cent. Approximately 8 lb. dried grass and 30 lb. molassed silage or AIV fodder were fed per head daily. Each ration supplied equal amounts of starch equivalent and digestible crude protein for maintenance and milk production.

There was no signficant difference between the four treatments in yield of milk or butter fat, butter fat percentages or live weight of the cows. The AIV fodder decreased the solids not fat content of the milk as compared with artificially dried grass which, at the level fed, replaced an equivalent quantity of starch and protein equivalent in concentrates.

The value of the N.P.N. in molassed silage and AIV fodder was high at the levels fed, and it is concluded that the digestible crude protein content of such fodders is a better guide to the feeding value than the digestible true protein or protein equivalent figures.

The carotene content of the milk was raised on all the experimental rations to a level expected under conditions of summer grazing. The increase was not so marked, however, with AIV fodder. [N. A. and R.]

WESTOVER, H. L. **Silage palatability tests.** *J. Amer. Soc. Agron.* 26. 106-16. 1934. [Divn. of Forage Crops and Diseases, Bur. Plant Ind., U.S. Dept. Agric.] **877**

The material used in the tests included plants normally ensiled, weeds and other plants both green and dry. Silage, made from alfalfa and corn alone, or from either mixed with other crops, was in the best condition and was the most highly palatable.

WHITE, R. G., and ROBERTS, E. J. **Silage for milk production. A comparison with roots and hay.** *J. Minist. Agric.* 29. 34-7. 1922. **878**

WIDJESKOG, I. AIV såsom svinfoder. [**AIV silage as pig fodder.**] *Tidskr. Lantm.* 29. 39-40. 1947. **879**

Feeding of breeding sows with clover-rich AIV fodder even in amounts less than 0.5 kg. per animal per day reduces considerably the risk of disease and the mortality among piglings. AIV fodder can be fed to bacon pigs as soon as they begin to eat : a suitable amount is from 0.5 to 2 kg. per animal per day according to age. Feeding with this fodder should be discontinued 3 to 4 weeks before slaughtering as it has a harmful effect on the colour and firmness of the bacon.

WILLIAMS, N. K., CANNON, C. Y., and ESPE, D. L. **Production of dairy cows when fed only silage and cracked soybeans.** *J. Dairy Sci.* 19. 459. 1936. [Iowa State Coll.] **880**

WILLIAMS, N. K., CANNON, C. Y., and ESPE, D. L. **A soybean and silage ration for dairy cows.** *J. Dairy Sci.* 26. 241-9. 1943. [Iowa State College, Ames] **881**

Cows fed on an experimental ration of soybeans and silage (corn and/or sorghum) produced slightly less milk, but more butterfat than did cows on a normal diet of grain and roughage. The experimental ration of soybeans and silage caused no marked change in milk flavour.

WILSON, H. F., ALLEN, N. N., BOHSTEDT, G., BETHEIL, J., and LARDY, H. A. **Feeding experiments with DDT-treated pea vine silage with special reference to dairy cows, sheep and laboratory animals.** *J. econ. Ent.* 39. 801-6. 1946. **882**

DDT residues remain on the pea vine up to the time of harvesting. Silage made from pea vines treated with 5 per cent dust at the rate of 40 lb. per acre contained less than 1 ppm. DDT. Cows fed this silage showed no ill effect. In another series of experiments DDT was added to pea vine silage, as the chopped vince was taken up by the blower, at the rate of 1 lb. DDT per ton of fresh vine. A sample from the bottom of this silo showed 653 ppm. DDT. Cows and sheep, calves and lambs showed no physical effects of feeding on this silage for 4 or 5 months. There was an accumulation of DDT in muscle, liver, body fat and milk. There was no evidence to show that DDT had any effect on milk production.

WILSON , W. K. **Silage as a winter foodstuff for rabbits.** *Harper Adams Util. Poult. J.* 28. 80-3. 1943. [Nat. Inst. Poultry Husb., Newport, Shropshire] **883**

In rabbit feeding experiments replacement of the whole of the bran ration by silage was not successful. It was difficult to get rabbits to consume more than 8 oz. silage per day. A mixture of bran and silage proved more palatable than silage alone, and silage of red clover and ryegrass was more palatable than lawn grass silage. The mixture of bran and silage gave the best growth results and the highest percentage of fertile matings and was superior to a ration of bran alone. The water consumption of the group on the bran and silage mixture was 100 per cent higher than that of the group on bran alone. [N. A. and R.]

WISE, G. H., LAMASTER, J. P., and MITCHELL, J. H. **Corn silage versus corn and soybean silage as the only roughage for milk production.** South Carolina Agric. Exp. Sta. Annual Report 1942-1943. pp. 68-70. 1944. [Clemson, S. Carolina] **884**

Maize silage and maize-soybean silage were fed as the sole roughage to two groups of milking cows over two 18-week periods in successive years. The mixed silage was richer in protein, calcium and carotene than the maize silage. Milk production, feed consumption and palatability were the same. Both roughages reduced appetite by compaction in the paunch. It was considered that, owing to the well-balanced diet provided, differences which might have been apparent under conditions of more restricted diets were eliminated. [D. S. A.]

WISE, G. H., MITCHELL, J. H., LAMASTER, J. P., and RODERICK, D. B. **Urea-treated corn silage vs. untreated corn silage as a feed for lactating dairy cows.** *J. Dairy Sci.* 27. 649-50. 1944. [Agric. Coll., Clemson Coll., S. Carolina] **885**

Ten lb. of urea, made up with water to 10 gal., were added to each ton of fresh ensilage material. The control silage was prepared with the same volume of tap water. A double reversal feeding trial was then conducted with the silages as the only roughage ; it involved 2 groups of 11 cows each and three 42-day periods. The urea-maize silage had a pH of 4.3, a brownish colour and a slightly caramelized odour. The cows found it somewhat less palatable than the control silage which had a pH of 3.6 ; they ate daily an average of 52.5 lb. of the urea silage and 60.0 lb. of the control silage. Milk production and gain in weight were almost exactly the same on the two silages. The low carotene value of the experimental silage produced a low carotene content in the milk.

It is concluded that nothing is gained by treating maize silage with urea. [D. S. A.]

WOLBERG, F. B., HODGSON, R. E., KNOTT, J. C., and ASHWORTH, U. S. **The digestibility of corn silage and mixed hay as determined by dairy cattle and sheep.** *Proc. W. Div. Amer. Dairy Sci. Assoc.* 1940. pp. 72-4. [W. Washington Exp. Sta., St. Coll. Wash., and Bur. Dairy Ind., U.S.D.A.] **886**

In the first experiment three mature lactating Holstein cows, three " in calf " Holstein heifers, and three cross-bred wether sheep were used. The ration consisted of maize silage (10.4 per cent of crude protein in the dry matter) for a 7-day preliminary period followed by a 12-day test period. The cows and heifers were confined in stanchions, fed twice daily, had access to water and were exercised each morning. The faeces were collected from each animal as excreted and 10 per cent was saved for chemical analysis. The sheep were confined in digestion cages and one half of the faeces was saved for analysis. In the second trial the same animals were used except that a substitute was necessary for one of the mature cows, and the trial was the same except that mixed hay (8.8 per

cent of crude protein in the dry matter) was fed in place of maize silage. The maize silage average digestion coefficients for cows, heifers and sheep respectively were : dry matter 65.8, 66.7 and 68.3 ; crude protein 61.2, 58.3 and 68.5 ; crude fibre 69.7, 74.1 and 73.8 ; ether extract 87.0, 86.5 and 86.5 ; N-free extract 69.1, 70.6 and 70.7. The corresponding values for mixed hay were, dry matter 57.2, 55.4 and 56.8 ; crude protein 46.9, 43.7 and 54.6 ; crude fibre 57.4, 56.5 and 55.2 ; ether extract 48.1, 51.6 and 52.6 ; N-free extract 64.0, 60.1 and 61.5. The average digestible crude protein and total digestible nutrients respectively in the maize silage were 6.38 and 68.23 when tested with cows, 6.07 and 70.21 with heifers and 7.14 and 71.21 with sheep. The corresponding values for digestible crude protein and total digestible nutrients respectively in the mixed hay were 4.14 and 56.1 with cows, 3.85 and 54.2 with heifers and 4.82 and 55.5 with sheep. Thus sheep were more efficient users of protein in the silage and the hay than the dairy cows or heifers. The total digestible nutrients of the two feeds with cows, heifers and sheep show very little difference and the trials indicate that digestion coefficients obtained with sheep may be applied to cattle feeding trials. [D. S. A.]

WYLIE, C. E., HINTON, S. A., and SHUEY, G. A. **Legume silage for dairy cows.** Tennessee Agric. Exp. Sta. Report 1941. pp. 28-9. 1942. **887**

Earlier experiments were continued for another winter. For the maize silage, lespedeza silage and alfalfa silage groups total cow-days in milk were 562, 558 and 562, total milk yields were 14,461, 13,832 and 15,327 lb., and total butterfat yields were 685, 65 and 669 lb., respectively. [D. S. A.]

ZEILER, K., and DEMETER, K. J. Die Beeinflussung der Milch durch Silagefutter. [**Effect of silage on milk.**] *Forschungsdienst* 4. 138-45. 1937. **888**

Bacteriological examination of the milk of large numbers of cows receiving silage as part of their ration showed that there was no direct relationship between the bacterial contents of the silage and the milk. The bacterial content of the milk was only slightly reduced by giving wood charcoal and $CaCO_3$ with the silage. [N. A. and R.]

ZELTER, S. Z., and LEROY, A. M. Expériences d'alimentation avec de l'ensilage de fourrages verts. [**Feeding trials with ensiled green forage.**] *Ann. agron., Paris* 18. 65-77. 1948. [Inst. Nat. Agron.] **889**

The silage was a mixture of oats and vetch, or the second, third or fourth cut of lucerne. The experiments were conducted over too

short a period (November to April) to draw definite conclusions but the following points emerged. Ensilage proved a very satisfactory way of making use of later cuts of lucerne which can rarely be converted into hay ; by feeding silage made of leguminous plants it was possible to reduce the supply of concentrates without affecting adversely the milk supply ; but this method of feeding is not recommended for cows whose milk is used for conversion into hard cheese (gruyère). It was not possible to draw conclusions regarding the different methods of ensilage.

ZOLLIKOFER, E., and RICHARD, O. Untersuchungen an Silagemilch. (Das Säuerungsvermögen von Milchsäurebakterien in Silagemilch.) [**The effect of silage feeding on milk. (The acid-forming power of lactic acid bacteria in milk from cows fed on silage.)**] *Annu. agric. Suisse* 44. 678-89. 1943. **890**

Demeter's original claim that milk from silage-fed cows sours more slowly than milk from other cows on account of its containing less than one tenth of the normal amount of riboflavin and *p*-aminobenzoic acid has not been confirmed. The authors can find no evidence to suggest that milk from silage-fed cattle either sours more slowly or contains less riboflavin than milk from cows fed otherwise. [D. S. A.]

ZOLLIKOFER, E., and RICHARD, O. Untersuchungen an Silagemilch. (Der Laktoflavingehalt von Heu- und Silomilch.) [**The effect of silage feeding on milk. (The riboflavin content of milks from cows fed on hay and silage.)**] *Ann. agric. Suisse* 44. 690-4. 1943. **891**

The riboflavin content of milks from cows fed on hay and three varieties of silage showed on the average little variation, 138 and 156 μg. per 100 ml. on hay as against 147, 161, 155 μg. per 100 ml. on the three silages. The riboflavin values were obtained colorimetrically. [D. S. A.]

ZORN, W., KRÜGER, L., LACHMANN, F., and FREIDT, G. [**Does generous and long-continued feeding of silage produce ill effects or damage to breeding capacity in cattle ? Studies of blood alkali reserve, calcium content and pH.**] *Z. Tierz. ZüchtBiol.* 50. 152-71. 1941. **892**

The feeding of large quantities of silage to young and mature cattle had no ill effects on their growth, development, milk and fat yield, fertility and general well-being. The results of four trials with 10 young bulls, 8 cows and 18 and 16 heifers respectively are reported, in which 20 to 50 kg. per head daily of various silages, including acid silage, were fed for 3 to 9 months. There appears to be no advantage in supplementing silage with lime and/or other

minerals. The alkali reserve, calcium content and pH values of blood were employed as additional criteria for measuring the effects of various treatments. Large variations between animals and periodical changes within the individuals were observed, but could not be attributed to the feeding of silage. The authors point out that the great controversy on the problem of ill effects due to the feeding of silage might have been built up on results of short trials, which would be open to similar variations, being in the past correlated with the silage treatments. [D. S. A.]

K. LATE UNCLASSIFIED ENTRIES

AGRICULTURAL IRELAND. **AIV silage.** *Agric. Ireland* 5. 243-5. 1948. **893**

Observations of the methods of grass conservation for winter feed practised in Sweden and Finland have shown that silage in these countries is made according to the AIV process, and its success has made the farmers completely independent of imported feeding cakes. In Finland cows have to be housed for 8 months of the year, yet there are plenty of farms where the herd average is over 800 gallons per cow, and where the ration includes no purchased concentrates, but instead the cows are fed AIV silage to the extent of 25 to 40 per cent of the total annual consumption of fodder.

The success of this AIV silage seems to be its method of making, which results in a universally good product free from obnoxious odours. It is significant that many big company farms in Sweden had given up grass drying for the dairy herd and gone over completely to AIV silage for high-protein feed.

The AIV system was introduced in Denmark in 1932, and during and after the war has become popular all over Europe. It would be difficult to exaggerate the importance of this AIV system of silage making as far as Éire is concerned, where the yield of cows is greatly in need of increase.

A small beginning has been made on some co-operative creamery farms, but if the work is to be extended, very considerable organization and staffing will be needed.

AMOS, A. **Observations on silage-making. Exclusion of air from concrete silos.** *J. Minist. Agric.* 52. 151-3. 1945. **894**

ANDERSSON, Y. Ensilering—en god metod att förvara foderpotatis. [**Ensiling—a good method of conserving fodder potatoes**] *Lantm. Svenskt Land* **32.** 656-7. 1948. **895**

A description of the method of ensiling steamed potatoes to be fed to pigs.

AXELSSON, J. Melass vid konservering av grönfoder. [**Molasses in the conservation of green fodder.**] *Lantm. Svenskt Land* 33. 113-4. 1949. **896**

Results of ensiling experiments in Sweden, Holland and the U.S.A., in which the molasses method was tested, are reported and discussed. The desirability of further experimentation is emphasized to stimulate interest in a rational fodder conservation.

Axelsson, J., and Eriksson, S. Bestämning av vallfodrets torrsubstanshalt vid förtorkning för ensilering. [**Determination of content of dry matter of ley fodder in predrying for ensiling.**] *Lantm. Svenskt Land* 32. 562-3. 1948. **897**

The best results of ensiling are obtained when the material placed in the silo contains 30 to 35 per cent dry matter. At the Institute of Animal Nutrition of the Agricultural College of Sweden an apparatus for determining the content of dry matter is employed. Data showing the time taken for the material (grass, lucerne, lucerne and clover) under specified climatic conditions to attain the requisite dry matter content are recorded.

Ayr, Hannah Dairy Research Institute. H.D.R.I. Reprint No. 115. **How to make good silage.** 1941. pp. 30. **898**

Beesley, D. W., and Richards, H. **Recent developments in silage making.** *Herefordshire Agric. J.* 2. 139-47. 1948. **899**

The two common methods of handling the crop, (a) the buck-rake and pit method, and (b) the green crop loader method, are described. The advantages and disadvantages of both are given, together with illustrations of implements used. A wide variety of crops can be grown for silage and in Herefordshire mixtures of winter oats, beans and vetches are common. Kale harvesting varies on each farm and the silage will keep until the following May. Silage making without molasses should be attempted only by experienced farmers and only on mature material.

Churchill, B. R. **Results of alfalfa grass molasses silage experiments at the Upper Peninsula Experiment Station.** *Quart. Bull. Mich. agric. Exp. Sta.* 22. 193-9. 1940. **900**

Cornell University Department of Agronomy. Mimeo. Publ. 833. **555 farm experiences with hay crop silage in 1947.** By *S. R. Aldrich.* 1948. pp. 5. **901**

Summaries are presented from reports from 555 farms in thirty-two counties. The following information is given : quality of silage, type of crop, date of cutting, wilting, equipment used, preservatives, kinds of silo and the advantages and disadvantages of making silage.

Csiki, L. [**The conservation of green fodders.**] Keszthely, 1928. **902**

Csiki, L. [**Fodder silos in Hungary.**] Keszthely, 1931. **903**

Dijkstra, N. D. **Silage making in the Netherlands.** *Emp. J. exp. Agric.* **16.** 231-6. 1948. [Hoorn Agric. Expt. Sta., Netherlands] **904**

This is a review of published experimental results in testing various methods. Warm fermentation in the Dutch clamp process is inferior to cold fermentation regulated by acid or sugar addition ; 4 per cent of molasses is required. Defu and AIV acid solutions are being used increasingly in Holland ; the fodder is palatable and harmless to stock. " Biosil " and " Dusarit " in which the acid is absorbed on charcoal, etc., made no headway in the Netherlands, nor did formic acid (formasil). Whey and skim milk proved useful for diluting molasses, but not for controlling pH when used alone. The Hardeland process under test consists in adding crushed beet with the material to be ensiled. Trials with solid CO_2 were inconclusive and trials with ' Virtasan ' a mixture of phosphates, ammonium salts, etc., gave poor results. " Drowning," e.g. 3300 kg. fresh grass ensiled with 500 litres of 25 per cent sugar solution, gave silage free from butyric acid and may be a useful method in districts where cheese is made.

DIJKSTRA, N. D. Proefnemingen over ensileren met Vitasan. [**Experiments in ensilage by means of Vitasan.**] *Maandbl. Landb-VoorlDnst* 5. 302-9. 1948. [Dept. Physiology, Agric. Exp. Sta., Hoorn, Netherlands] **905**

Reference is made to the findings of Bartels and Boettcher (*Herb. Abstr.* 18. Abs. 1149) and an account is given of experiments in the ensilage of grass by means of Vitasan, a compound of salts, at Hoorn in 1946 and 1947. The control was silage made of the same cut of grass, but without the addition of any chemical or other means of conservation. The quality of the Vitasan silage was slightly better in some respects (somewhat lower pH and butyric acid content and higher lactic acid content), but feeding trials with three wethers showed little difference in the digestibility of the two silages. In a feeding trial with twenty-four dairy cows, the Vitasan silage had no better effect on milk and milk fat production, on live weight and general condition of the animals than did the control silage.

DONALDSON, F. T., and GOERING, K. J. **Russian thistle silage.** *J. Amer. Soc. Agron.* 32. 190-4. 1940. [Montana Agric. Expt. Sta., Bozeman, Mont.] **906**

In order to determine the possibility of preserving the immature plants of *Salsola pestifer* in a succulent condition, laboratory trials were made of three types of silage. These plants are equivalent to alfalfa in protein and fat content, and superior in carbohydrate/crude-fibre ratio. Good silage can be prepared with the addition of either sugar or H_3PO_4.

EKELUND, S. Ensilering med tillsats av syra eller socker? [**Ensiling by the addition of acid or sugar**?] *Lantm. Svenskt Land* 33. 87. 1949. **907**

In the U.S.A. the material ensiled is in general much richer in sugar than the material used in Sweden. A new Swedish method of ensiling is described in which butyric acid replaces AIV acid.

ENGLAND and WALES, Ministry of Agriculture and Fisheries. Growmore Leaflet No. 28. **Ensilage in war time.** 1940. pp. 8. **908**

ENGLAND and WALES, Ministry of Agriculture and Fisheries. Growmore Leaflet. No. 50. **How to judge the feeding value of silage.** 1940. pp. 2. **909**

ENGLAND and WALES, Ministry of Agriculture and Fisheries. Growmore Leaflet No. 92. **Growing crops for silage.** 1945. pp. 4. **910**

ESGUERRA, J. P. **The cost of producing corn silage at the College of Agriculture.** *Philipp. Agric.* **29.** 327-41. 1940. [Dept. Animal Husbandry] **911**

Data were collected at Laguna on the expenditure on labour and machinery, etc., incidental to producing corn silage for 3 wet and 2 dry season crops. It has been calculated as a result that the cost was 17.18 pesos per ton.

FRANCE, Co-operative Agricole Laitière du Talou. L'ensilage des queues de betteraves sucrières. [**Ensilage of sugar beet tops.**] 1948. pp. 73. **912**

The paper first discusses proteins in the diet of cows and the manner in which they are furnished by the sugar beet. Sugar-beet silage is superior to fodder-beet silage by the equivalent of 1.5 kg. flax cake. Construction, size, filling, sealing and emptying of the trench and tower types of silo are considered. It is preferable to ensile both pulp and tops because the pulp, on trampling, forms a layer impermeable to air, a condition difficult to obtain with tops alone. The by-products of a hectare of sugar beet can feed 4.5 cows throughout 180 days of indoor winter feeding.

An appendix gives dimensions for tower and trench silos, advice on the use of formic acid in ensilage, data on yields obtained by early sowing of sugar beet, data on nutritive value of sugar-beet silage and comparisons with other animal fodders and forage (given in terms of dry matter, digestible protein, starch equivalent, and calcium and phosphorus content). Tables give rations for dry and milking cows when fed silage of sugar-beet tops. The monetary values of sugar-beet tops used for silage and for green manure are compared. From 1 ha. of land the value when used for silage is 40,000 fr.; for green manure it is 7,000 fr. [French francs in 1948.]

GIULIANI, R. Tecnica dell'insilamento e tipi di sili. [**Technique of silage and types of silos.**] *Riv. Zootecn.* 17. 81-107. 1940. **913**

This is a report on grass silage presented to the " Meeting for Fodder Conservation " held in Verona in March, 1940. The author considers that failures are due rather to faulty technique than to the type of silo employed. Hay or grass in the silo undergoes transformations which are due to (1) cellular respiration, (2) activity of the protoplasmatic enzymes, and (3) microbic activity. Cellular respiration causes a loss of organic substances (especially sugars) and increase in temperature. Enzyme activity causes a loss in proteins. Microbic activity is the most important factor. According to C. Arnaudi and T. Politi of the Crema Exp. Sta. of Agric. Bacteriology, there are three types of bacteria : those which attack the carbohydrates and produce predominantly lactic acid ; those which act on carbohydrates and produce predominantly butyric acid ; and those which attack the nitrogenous substances. The action of these bacteria in relation to temperature and type of silage is examined. These bacteria are harmful with the exception of those producing lactic acid. This compound favours silage conservation. Its formation is dependent on the sugar content, but is prevented by increase in temperature. After reviewing the characteristics of a good silage, the author describes the different systems of ensilage based respectively on artificial acidification by mineral acids, self-heating and consequent partial sterilization of the grass, and natural acidification of grass or the cold silage system. The last method, which induces a rapid formation of lactic acid at a low temperature, is considered to be the most important. The different types of silos are classified. Fodders rich in sugar, such as maize and sorghum, are easily preserved ; on the contrary, the ensiling of leguminous plants is difficult, and advice is given in this respect. The best solution is to ensile the grass when dry. If instead a fresh silage is desired, uniform and strong pressure on the grass, and hermetically sealed silos are necessary. If possible, 10 per cent of a sugar fodder should be added.

GIULIANI, R. Su la possibilita di ottenere mangimi concentrati proteici dall'essiccamento artificiale dell'erba giovane. [**The possibility of obtaining protein concentrate cattle food from the artificial drying of young grass.**] *Riv. Zootecn.* 17. 117-41. 1940. **914**

The author refers to research carried out on the subject in Great Britain, particularly by H. E. Woodmann and S. J. Watson, and also in the United States of America and in Germany (where this process is also used for sugar beet residues). The author is of the opinion that, not considering the cost, this process could be of

great value in Italy where large quantities of protein concentrates or oil seeds for their preparation are imported annually while the increasing cultivation of leguminous crops would make it possible to produce these foodstuffs locally.

GIULIANI, R. Considerazioni conclusive sul pascolamento, su la fienagione e su l'insilamento. [**Conclusive considerations on pasturing, haymaking and ensilage.**] *Riv. Zootecn.* 17. 185-91. 1940. **915**

The three systems of fodder utilization are compared and the function they should fulfil in a modern farm indicated. A table shows the absolute and relative nutritive value obtained with grass from 1 hectare of good permanent meadow, when the three systems are adopted under different conditions. An indication of the financial losses involved is also given. It is estimated that in practice the loss in nutritive value in good silage is not higher than 20 per cent, while with pasturing and haymaking losses in most cases exceed 30 per cent. Pasturing has the advantage of keeping animals in good health. The suitability of haymaking is dependent on climate and on quality of the fodder. It is more successful in regions and in seasons with a low rainfall, and with grass from permanent meadows rather than with leguminous crops. It is impracticable with forage catch crops (maize, sorghum, etc.). Haymaking should be carried out with the intermediate cuts (of the dry summer season) from the natural meadows, and later from the leguminous artificial leys. Ensilage is likely to have special value for the conservation of forage catch crops (maize, etc.) and also of grass from the first and last cuts of natural and artificial meadows taken in May and October respectively, in periods when rainfall is generally high. Ensilage with leguminous artificial leys should be preceded by drying in order to obtain " hay-silage". Otherwise it is necessary to add a sugary fodder, or molasses, or to apply acid treatment.

GIULIANI, R. Esperienze comparative di insilamento di favetta ed orzo in sili " universali " con e senza chiusura ermetica. [**Comparative trials of silage of little horse bean and barley made in " universal " silos with and without hermetic seals.**] *Riv. Zootecn.* 17. 223-30. 1940. **916**

The " universal " hermetically sealed silo, invented by T. Pestellini and the author, consists of a tank usually buried in the ground ; it has a gully, but no windows, and is closed by a plate cover provided with a marginal ring fitting in a corresponding track in the silo wall which contains a non-evaporating liquid. In this type of silo, which has also proved successful for green fodder from leguminous crops, the maintenance of an internal low temperature

is essential ; for this purpose the grass is ensiled immediately after cutting, and during the coldest periods of the season and of the day. Because of difficulties in the supply of iron during the war, some farmers have adopted seals of cement or " eternit " (a composite material), while others have substituted the seal with a layer of soil (40 to 50 cm.) and have still obtained good results. The trials carried out by the author had the object of comparing the two systems and of determining the losses in organic matter. Two silos were filled with fresh grass from a summer-autumn catch crop. Silo A was covered with 25 cm. of soil and was closed with the hydraulic seal. Silo B was covered with 40 cm. of soil and protected with a wood cover. After 110 days, on March 9th, the silos were opened and the contents examined. Results have proved satisfactory with both silos. Losses in organic substances were 10.82 per cent (silo A) and 13.11 per cent (silo B), and losses in digestible protein 23.23 and 16.81 per cent respectively. It still remains to be demonstrated whether similar results are obtained by ensiling in the warm season, when the fermentative processes are more pronounced.

GOTHARD, S. Herenyi. [**Ensilage particularly concerning the " zsombolyai " stack silage (warm fermentation)**] *Köztelek* 1892. pp. 642 and 682. **917**

GOTHARD, S. Herenyi. [**Conservation of green fodder.**] *Köztelek* 1892. p. 1054. **918**

GROFFITS, G. [**Cheap fodder silos.**] *Köztelek* 1929. p. 2141. **919**

HOWE, J. W. **Soiling crops and silage.** *J. Jamaica agric. Soc.* 46. 257-8. 1942. **920**

ILLUSTRIERTE LANDWIRTSCHAFTLICHE ZEITUNG. [**Ensilage of fodder.**] *Ill. landw. Ztg.* 1902. p. 728. **921**

ILLUSTRIERTE LANDWIRTSCHAFTLICHE ZEITUNG. Farmers' Bulletin 32. [**The silage of green fodder**] *Ill. landw. Ztg.* 1903. p. 719. **922**

JENSEN, H. L. Roetoppens ensilering. [**Ensiling of root tops.**] *Ugeskr. Landm.* 93. 691-3. 1948. **923**

A computation made in 1946 showed that only on 22 per cent of all the farms in Denmark, large and small, was ensiling practised, and that in very many instances earth pits were used. Owing to the difficulty in obtaining material for the construction of silos, comparatively little progress has been made in ensiling during the last few years.

Cheap Finnish silos consisting of an imbedded under-silo and a moveable over-silo can be used to ensile root tops. Detailed directions are given for the preparation of earth pits. Danish trials indicate that it is advantageous to use AIV acid in conserving root tops; but this is not indispensable. The addition of sour milk or whey is not to be recommended. Cooking salt should not be used.

This year (1948) there is in Denmark a very large crop of beet tops, and they are particularly valuable for ensiling. In districts where swede tops are healthy and undamaged by insect attack, they too can be ensiled with excellent results.

JOURNAL OF THE DEPARTMENT OF AGRICULTURE, ÉIRE. **Grass silage demonstrations 1939-1941.** *J. Dept. Agric. Éire.* 40. 5-22. 1943. **924**

JOURNAL OF THE MINISTRY OF AGRICULTURE. **Marrow-stem kale for silage.** *J. Minist. Agric.* 50. 77-8. 1943. **925**

KANSAS Agricultural Experiment Station. Bull. 320. **Grass and alfalfa as silage, forage and meal for poultry.** By *Loyal F. Payne* and *Clarence L. Gish.* 1943. pp. 46. **926**

KERSHAW, C. J. **Pasture silage making in the Circular Head Municipality.** *Tasm. J. Agric.* 19. 168-75. 1948. [Dist. Agric. Officer] **927**

The report describes various phases of silage making by the stack method, carried out by twenty-five farmers of Circular Head. General information is given on principles of silage making, reasons for the stack method, area harvested, general procedure, harvesting, and stacking, site of stack, labour and equipment employed and palatability of the final product to dairy stock. Finally farmers' comments prove that the making of pasture silage can well afford to be included in the programme of work on the average North-West Coast dairy farm.

KIRSCH, Dr. W. [**The results of cold fermentation. I and II.**] *Ill. landw. Ztg.* 1928. pp. 667 and 675. **928**

KIRSCH, W. [**Problems of fodder conservation.**] *Futterbau und Gärfutterbereitung* 1937. p. 4. **929**

KOVATSITS, K. [**Ensilage is the most reliable method to make our cattle breeding profitable.**] *Köztelek,* 1929. p. 1968. **930**

KOVATSITS, K. [**The production of silomaize.**] *Köztelek,* 1930. p. 1735. **931**

KOVATSITS, L. [**Some economic results of maize "silo farming."**] *Köztelek*, 1931. p. 523. **932**

KOVATSITS, L. [**Ensilage of fodder, particularly concerning cold fermentation, I and II.**] *Köztelek*, 1931. pp. 1082 and 1103. **933**

KOVATSITS, L. [**Some data on cold fermentation of silo fodder.**] *Mezögazdasag*, 1932. p. 118. **934**

KOVATSITS, L. [**What ought we to know about the modern fodder silos?—I and II.**] *Köztelek*, 1933. pp. 766 and 780. **935**

KOVATSITS, L. [**A criticism of Virtanen's fodder conservation method.**] *Allattenyesztök Lapja* 1934. p. 260. **936**

KOVATSITS, L. [**Voltz's cold fodder fermentation.**] *Allattenyesztök Lapja* 1934. p. 273. **937**

KOVATSITS, L. [**Present position of ensilage at home and abroad.**] *Cukorrepa*, 1934. p. 190. **938**

KOVATSITS, L. [**The most important fodder plants of Hungarian "silo-farming".**] *Köztelek* 1934. p. 162. **939**

KOVATSITS, L. [**Modern Hungarian "silo farming."**] *Magyarovar* 1934. **940**

KOVATSITS, L. [**Silo maize, instead of beet.**] *Mezögazdasag*, 1934. No. 2. p. 6. **941**

KOVATSITS, L. [**Cold fermentation of fodder with and without hydrochloric acid.**] *Allattenyesztök Lapja* 1935. p. 23. **942**

KOVATSITS, L. [**Simple and reliable methods for rational conservation of fodder.**] *Allattenyesztök Lapja*, 1935. p. 125. **943**

KOVATSITS, L. [**Production of silomaize is worth while.**] *Köztelek*, 1935. p. 361. **944**

KOVATSITS, L. [**Acidification of sugar beet tops and beet pulp, I and II.**] *Cukorrepa*, 1936. pp. 164 and 182. **945**

KOVATSITS, L. [**The real importance of ensilage in our agriculture.**] *Mezögazdasagi Közlöny* 1937. p. 120. **946**

LANDBRUGSRAADETS MEDDELELSER. Ensilagebeholdene og Jordkuler til Ensilage 1948. [**Silos and earth pits for silage (in Denmark) in 1948.**] *Landbrugesraadets Meddelelser* No. 6. 169-70. 1949. **947**

In 1948 the number of farms provided with silos was approximately 30,400 compared with 28,600 in 1946. Of these farms in 1948 fully 1500, and in 1946 barely 1600, had also earth pits for silage. The number of farms on which there were only earth pits, without silos was in 1948 approximately 20,550 and in 1946 fully 17,000. The total number of farms on which it was possible to carry out ensiling amounted thus in 1948 to 50,900 and in 1946 to 46,400. The figures correspond respectively to about 24 and 22 per cent of the total of agricultural holdings. Progress from 1946 to 1948 has been slightly more marked on the islands than in Jutland.

LECOUTEUX-ORDODY. [**Green maize and other green fodders.**] Budapest, 1885. **948**

MCAULIFFE, H. D., STONE, R. W., and BECHDEL, S. I. **Fermentation studies on alfalfa silage prepared by the phosphoric acid and molasses method.** [Abstract of paper to 35th Ann. Meeting Amer. Dairy Sci. Assoc.] *J. Dairy Sci.* 23. 561. 1940. [Pennsylvania State Coll.] **949**

Alfalfa silages prepared under exactly comparable conditions with various concentrations and mixtures of molasses and phosphoric acid were studied with respect to the micro-organisms present and the chemical changes produced.

MCLEAN, W. **Silage making in North Wales.** *J. Minist. Agric.* 50. 74-7. 1943. **950**

MERCADO, R. G. **Corn-tapilan silage as supplement to pasture for range cattle during the summer months.** *Philipp. Agric.* 29. 350-64. 1940. **951**

Twelve cattle in two lots were grazed on a pasture consisting of *Imperata cylindrica* var. *Koenigii*, *Cynodon dactylon*, *Eleusine indica*, *Paspalum conjugatum*, and various weed species. One group was given a supplementary feed of maize-tapilan silage, in which the two species were present in the proportion of 1.9 : 1.0 by weight. The animals were weighed every 4 weeks during the 20 weeks of the experiment.

The cattle receiving the silage made higher average weight increases than those depending solely on the herbage.

The pasture did not suffer from overgrazing, but it became less palatable during the warmer and drier part of the summer.

MEZÖGAZDASAGI SZEMLE 1891. pp. 30, 213, 327 and 529. Further 1892. pp. 36, 61, 107, 119, 153 and 269. **952**

MOORE, H. I. **Silos and silage.** 19 × 13. pp. viii + 112. pls. London : The Farmer and Stockbreeder, Dorset House, Stamford Street, London, S.E.1. 1941. 3s. 6d. **953**

The book is written in non-technical language, embodies the latest information on the subject and outlines methods which the author's experience has shown to be sound and practicable. Information is included on the following aspects : principles of silage making, crops used, silo types, feeding silage to stock, and costs. There are also specifications of silos for home manufacture and a tabulation on the approximate nutritive values of various types of silage.

NAUE, Ing, Dr. Kurt. [**The German greenfodder silo.**] Berlin, 1926. Paul Parey. **954**

NORTHERN IRELAND, Monthly Report of the Ministry of Agriculture. **Silage for self-sufficiency. VII. The practice on a County Fermanagh farm.** *Mon. Rep. Minist. Agric. N. Ire.* 23. 290-1. 1949. **955**

Continuing this series of articles, the experience of a 260-acre County Fermanagh farmer is described. Numbers of stock in 1948 were eighty cows, twenty in-calf heifers, ten bulling heifers, twelve yearlings, fourteen calves and one stock bull, and crop areas were 14 acres oats, 5 acres of potatoes, 4 acres of oats and rye for silage, 50 acres of permanent grass made into hay and 25 acres for ensilage. To save labour a trench silo with concrete sides and sloped ends was used so that tractors and trailers could drive through the silo. Using a sweep and trailers, loading and unloading with forks, consolidating by treading and drawing tractors and trailers across the silage several times, and by adding 1 gallon of molasses per ton of herbage, 400 tons of silage were made in 1948.

Rations for the cows include 50 lb. of silage per head in two feeds per day, concentrates at the rate of 2 lb. per gallon of milk and hay to complete the ration. Because of the difficulty of tillage of the land the farmer prefers grass silage to an arable crop, and his aim is to make silage the main winter food for stock and to save less hay of better quality.

PERALTA, M. C. Recomendaciones practicas sobre ensilaje. [**Practical hints on ensilage.**] *Agric. trop.* 4. No. 7. 19-21. 1948. **956**

Advice for the Colombian farmer.

PURDUE UNIVERSITY Agricultural Experiment Station Circ. 285. **Alfalfa-brome grass silage for dairy cows.** By *J. W. Wilbur, R. K. Waugh, S. M. Hauge and J. H. Hilton.* 1943. pp. 8. **957**

RIPLEY, P. O. **Silage in Canada.** *Emp. J. exp. Agric.* 16. 237-40. 1948. [Central Exptl Farm, Ottawa] **958**

Stall feeding is often for 7 months of the year ; there are about 45,827 silos in Canada, about 10 per cent of farms have silos if grain-growing provinces are excluded, and about 20 per cent in Ontario when maize silage is made. About 400,000 acres are under maize. Climatic requirements and the high cost of maize growing are unfavourable factors. It is not as easy to make good silage of grass and legumes as from maize ; there are greater nutrient losses in the silo and greater costs for handling green crops than field-cured hay. The Ronning harvester blower for maize is useful but expensive ($1500) and too large for farms growing normally 8 acres of maize. A forage crop harvester is being developed which will pick up field-cured hay, green crops for silage and maize for silage, and will chop and blow the crop to the silo. 150 machines have been sold in Canada up to 1948. Farmers are recommended to use molasses ; they have not taken to the use of acids. Tower silos 12-14 ft. in diameter and 30 ft. high are the most popular.

RIVISTA DI ZOOTECNICA. Conservazione dei foraggi. Principi scientifici e tecnici dell'insilamento dei foraggi. [**Fodder conservation. Scientific and technical principles of fodder silage.**] *Riv. Zootecn.* 19. 24-37. 1942. **959**

This article gives a summary of the work by E. Crasemann, director of the Institute for Animal Feeding, Polytechnical School, Zürich, entitled " Principes scientifiques et techniques de l'alimentation des animaux domestiques."

ROBINSON, H. G. **Silage.** *J. Minist. Agric.* 48. 199-203. 1942. **960**

SHEPHERD, J. B. **Effect of depth of corn in the silo in weight of corn silage.** [Abstract of paper to 35th Ann. Meeting Amer. Dairy Sci. Assoc.] *J. Dairy Sci.* 23. 563-4. 1940. [Bur. Pl. Ind., U.S. Dept. Agric.] **961**

At the Beltsville Research Center, most of the corn is ensiled when the ears are slightly to well-dented, but before they are fully dented and hard. Data have been collected on the weight of green corn placed in eight silos, on the total weight of corn silage removed from six silos, and on the weight per cubic foot at different depths of the corn silage removed from five of these silos.

TEXAS Agricultural Experiment Station. Bull. No. 659. **Sorghum silages and dehydrated alfalfa leaf meal as sources of carotene in beef cattle fattening rations.** By *J. H. Jones, J. M. Jones, G. S. Fraps, A. R. Kemmerer, R. E. Dickson, C. E. Fisher* and *N. R. Ellis.* 1944. pp. 27. **962**

Dehydrated alfalfa meal contained much more carotene than the sorghum silages. Sweet sorghum silage contained about twice as much carotene as the grain sorghum silage. Approximately 1 lb. sweet sorghum silage fed daily per 100 lb. live weight may effect protection against vitamin A deficiency, but 2 to 3 lb. grain sorghum silage would be required to obtain the same degree of protection.

UNITED STATES, Department of Agriculture, Agricultural Research Administration, Bureau of Dairy Industry. BDIM—Inf—38. **How to put up wilted grass silage.** By *J. B. Shepherd.* 1946. pp. 4. [Mimeographed] **963**

Although there is a considerable loss of carotene due to wilting the crop before ensiling, wilted silage, as fed at the Agricultural Research Centre, Beltsville, contained two to three times as much carotene as is usually found in hay as fed. Good silage will result as long as the following points are observed. Silos should be airtight and have smooth walls. Legumes and immature grasses should be wilted only slightly after they are cut. When put into the silo, their moisture content should not be above 68 and not be below 60 per cent. To give close packing, the cutter should be set at one-quarter inch for best results. The silage should be distributed evenly; material in the top half or third of the silo should be only very slightly wilted as heavy moist material will pack closer and press out more air. 4 to 6 feet of finely chopped unwilted silage should be put on top of the wilted silage. When the filling is completed, the top should be levelled leaving the silage slightly higher near the wall than at the centre. When the silage is settling it should be kept well compacted, particularly near the wall.

UNITED STATES, Department of Agriculture, Agricultural Research Administration, Bureau of Dairy Industry BDIM—Inf—43. **Comparative efficiency of siloing, barn curing, and field curing forage crops.** By *J. B. Shepherd, R. E. Hodgson, L. G. Schoenleber, H. M. Tysdal, R. E. Wagner, W. H. Hosterman, L. A. Moore, H. G. Wiseman, C. G. Melin, M. A. Hein,* and *T. E. Hienton.* 1946. [Revised 1947] pp. 15. [Mimeographed] **964**

The results of 2 years' studies have shown that much larger amounts of dry matter, protein, and carotene were obtained by making forage into silage than by making it into either field-cured or barn-cured hay, under the climatic and crop conditions that prevailed during the harvesting periods. When fed on an equal dry

matter basis, the silage was equal for milk production to good quality hays made from the same crops at the same time. The cows also maintained their live weight and condition better on the silage than on the hays.

The carotene content of alfalfa silage may vary considerably, depending on such factors as stage of maturity of the crop, the amount of weeds and other foreign material present, and the methods of handling. However, the carotene content of silage was always higher than that of either barn-cured or field-cured hay made from the same crop at the same time. Therefore, the silage produced butter with a much higher vitamin A content than either kind of hay.

These advantages of silage were obtained with very little additional labor and with no higher machinery requirements for harvesting and preserving the crop. The barn-curing method, while not so efficient as the silage method, was considered more efficient than field curing, but required the additional expense of fan operation. The advantages of the silage and barn-curing methods over the field-curing method might have been considerably greater if rainy weather had occurred during the harvesting periods.

VEALE, R. J. **Silage making with special reference to the use of green peahaulm or trash.** *Tasm. J. Agric.* 16. 103-6. 1945. **965**

VIVET, E. L'ensilage des fourrages verts en Afrique du Nord. [**Ensilage of green forage in North Africa.**] *Rev. Bot. appl.* 20. 635-6. 1940. **966**

WATSON, S. J. **Kale silage.** *Farming* 2. 339-42. 1948. **967**

Reasons for the increased practice of the ensilage of kale in recent years, and its advantages, are given. Various methods as advocated by certain exponents of silage making are mentioned. Handling the kale is always a problem, but it can easily be arranged with an old mower if necessary. The cutter-blower is essential if good silage is to be made, and this is the easiest way to fill the crop into the silo. The uses of straw and the feeding value of kale in silage making are described.

WILSON, J. K. **Changes occurring in silage as affected by salt.** *J. Amer. Soc. Agron.* 40. 901-7. 1948. [N.Y. St. Coll. Agric., Ithaca] **968**

Tests were carried out in an attempt to evaluate the affect of salt on the quality of silages as indicated by the pH values, and gaseous emanation of the resulting product. Silages were made

from fourteen different crops. In some of the silos common salt was added to the chopped material; other silos which contained no salt were used for comparison. Data indicated that salt does not induce lower pH values in silage. However the addition of salt to the ensiled crop delayed the emanation of gases and caused greater seepage in the first day or two, though the total seepage from silages made with and without the addition of salt was about equal. Total solids in the seepage after nine days appeared to be slightly larger if salt were used. The loss of solids in the seepage did not exceed 0.2 lb. per ton of silage.

It is concluded that the value of salt in silage making is still to be demonstrated.

ZAITSCHEK, Dr. A. **The acidification of fodders.** *Köztelek* 1927. p. 155. **969**

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